UNIV OF

Electrical World

OCTOBER 2, 1943

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ELECTRONIC GUN "SPOT WELDS" VENEER ON A MANDREL

"A FIRST CLASS INSTALLATION", *say electricians*

(*and they also say,* "SO EASY TO PUT IN")

Arc-quenching construction in 2, 3 and 4 Pole, 30, 60 and 100 Ampere Safety Switches.

SKETCHED above is the switch block from a Murray Single Throw, Fusible, Type D, Safety Switch. In the circle is the outstanding feature — the double break blade and arc quenching chamber.

Each blade is provided with a double break — the arc is broken into two parts. The burning is greatly reduced by this feature. Whatever arc is formed at each of the two breaks is drawn into a narrow slot in the mounting base where it is lengthened-out and cooled — the effects co-acting to quench the arc almost instantly.

This arc-quenching construction coupled with those Murray Switch characteristics as ample wiring room, properly placed knockouts, good-looking cabinets, assure the electrician the satisfaction that comes from a first-class installation. Metropolitan Device Corporation, Brooklyn, New York.

Write for the facts — no obligation!

Murray

SAFETY SWITCHES

THERE ARE MURRAY JOBBERS EVERYWHERE

Keep On

BUYING WAR BONDS AND STAMPS

TK1
E5
v.120:2

Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 69 YEARS

October 2, 1943 — Vol. 120, No. 14

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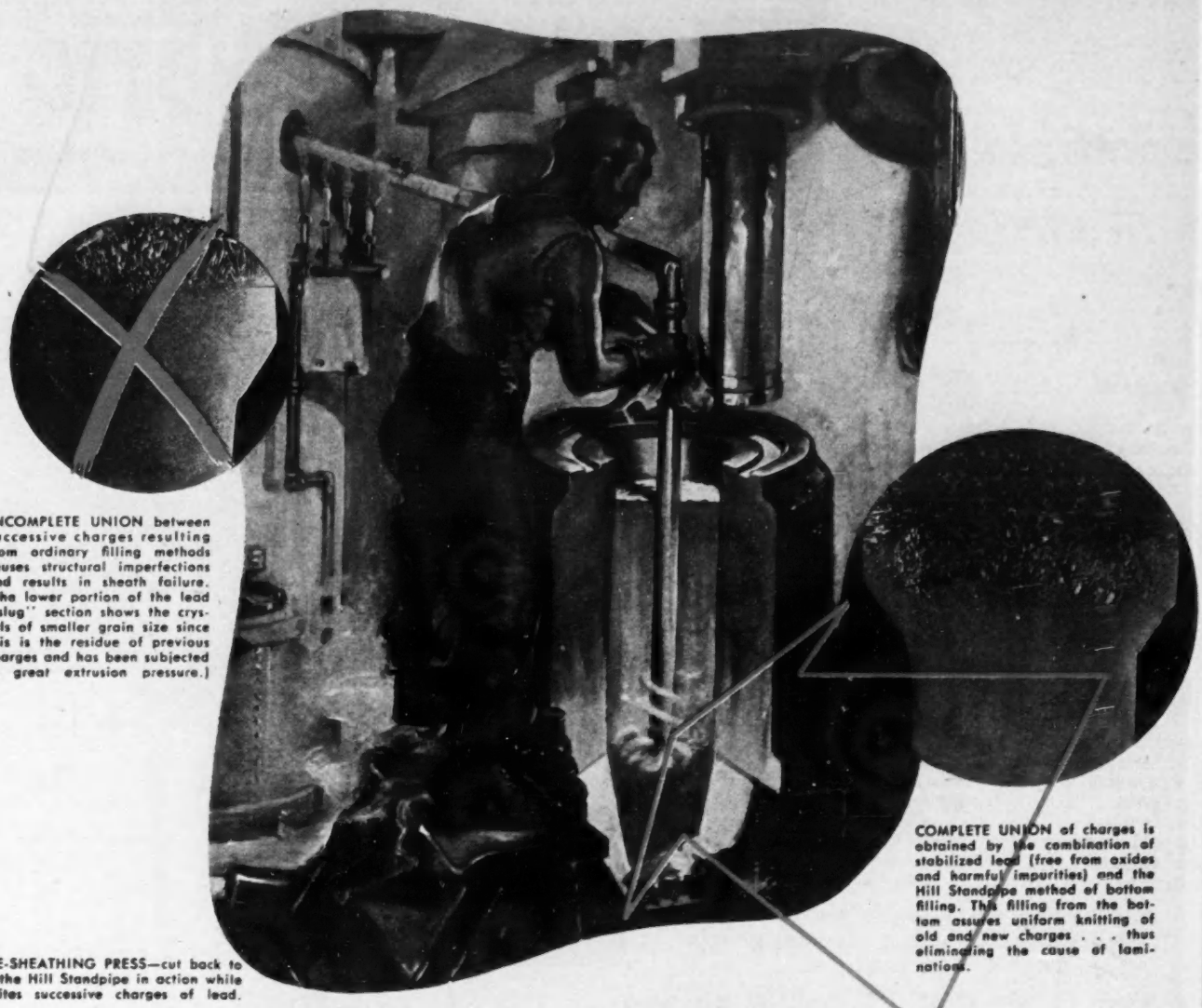


INCOMPLETE UNION between successive charges resulting from ordinary filling methods causes structural imperfections and results in sheath failure. (The lower portion of the lead "slug" section shows the crystals of smaller grain size since this is the residue of previous charges and has been subjected to great extrusion pressure.)

CABLE-SHEATHING PRESS—cut back to show the Hill Standpipe in action while it unites successive charges of lead.

COMPLETE UNION of charges is obtained by the combination of stabilized lead (free from oxides and harmful impurities) and the Hill Standpipe method of bottom filling. This filling from the bottom assures uniform knitting of old and new charges . . . thus eliminating the cause of laminations.

THROUGH OKONITE-CALLENDER RESEARCH . . .

YOU CAN HAVE PAPER CABLES WITH UNIFORMLY STRONG LEAD SHEATHS

Laminations and inclusions . . . the most common causes of lead sheath failures in service . . . are attributed to inability to control several variables, including the uniformity and chemical purity of the lead and the methods used in applying it to the cable.

A series of Okonite-Callender research developments have supplied methods for controlling these factors. Foremost among these—

1. We can control the uniformity and arrangement of the lead crystals by chemical treatment. 2. We remove original impurities, and at the same time prevent their recurrence during the lead sheathing operation by "stabilizing" the lead through our sodium treatment. 3. We obtain complete union between successive charges of the lead press by using our Hill Standpipe method of press-filling (as shown above).

Some of these developments were made part of regular factory procedure at least 7 years ago. *Since their adoption not a single lead sheath failure due to laminations or inclusions has been reported for any Okonite-Callender cable.*

Additional methods have been introduced as further research demonstrated their usefulness. And current research is revealing new data that will lead to even greater improvements in the lead sheathing of paper cables. The Okonite-Callender Cable Co., Inc., Passaic, N. J.

OKONITE CALLENDER

PAPER INSULATED POWER CABLES

IN CASE OF FIRE CALL GraybaR

...or FAST-ACTING EMERGENCY SUPPLY SERVICE . . . call on Graybar's Utility Supply-Corps

Fires, floods, windstorms, and other emergencies which interrupt power transmission or distribution are important "test-cases" of GRAYBAR service.

Recently, for example, a fire made it necessary to install new cable to feed an important plant making bomber parts. Yet supplies in the area were "out," and a serious delay seemed inevitable.

The local GRAYBAR representative, however, was able to locate an acceptable alternate on hand at a truck manufacturing plant only thirty miles away. Electrical service was restored overnight.

Similarly, pole lines damaged by recent floods were more quickly restored, as GRAYBAR moved in new poles, hardware and wire from points outside the flood zone.

Technical understanding of your needs, "know-how" on priority and transport, and a network of warehouses stocked to make the most of limited supplies—all these factors work for you "via GRAYBAR".

Many electric service companies keep closely in touch with GRAYBAR on supply stocks *all the time* to assure fast aid should emergencies strike. Is yours one of them?

Executive Offices: GRAYBAR BUILDING New York 17, N. Y.

GraybaR

IN OVER 80 PRINCIPAL CITIES

"GraybaR" Everything Electrical . . . THAT IT TAKES TO WIN!

Flexible Cables

FOR PORTABLE AND MOBILE *Electrical* EQUIPMENT

Rubber sheathed flexible cords and cables for portable or mobile electrical equipment were made first by Simplex and introduced about twenty-five years ago. They quickly proved their superiority for such service over older types of cables and were soon in general use.

Simplex-TIREX - rubber sheathed - cords and cables have been the acknowledged leaders in this field ever since. Improvements made from time to time have maintained their leadership and millions of feet of tough, abrasion resistant Simplex-TIREX are in service today.

Recent government regulations prohibit the use of natural rubber in insulation or sheath. Synthetic compounds have been developed to carry on for the duration and already have proved their ability to render satisfactory service. They will fill in now for the Simplex-TIREX that, during the past quarter century, has built up such enviable performance records in mines, mills and wherever electrical equipment depends upon flexible conductors for power.

SIMPLEX *War* TIREX——

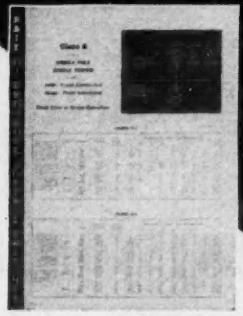
cords and cables with synthetic insulation and sheath are available for essential projects. If you need cords or cables for machines or tools engaged in war work, you should learn what Simplex "War" Tirex cords and cables can do for you.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

Simplex WIRES and CABLES

CHECK the FACTS

1. **SWITCH OPERATION** made easy through shuffle pryout release.
2. **POSITIVE LATCHING AND UNLATCHING** controlled by integral handle and lock.
3. **SPOT CONTACTS** - self cleaning with each operation under Hi-Pressure.
4. **INDIVIDUAL PRESSURE SPRINGS** insure uniform contact loading.
5. **HINGE CONTACTS** - uniform in all blade positions through Hi-Pressure, annular, line contact surface - dirt free, smooth operating.



For standard switch designs, consult Bulletin 1310. Switches for Panel and Switchboard application are made in any voltage or capacity.

R&IE

DISCONNECTING SWITCHES

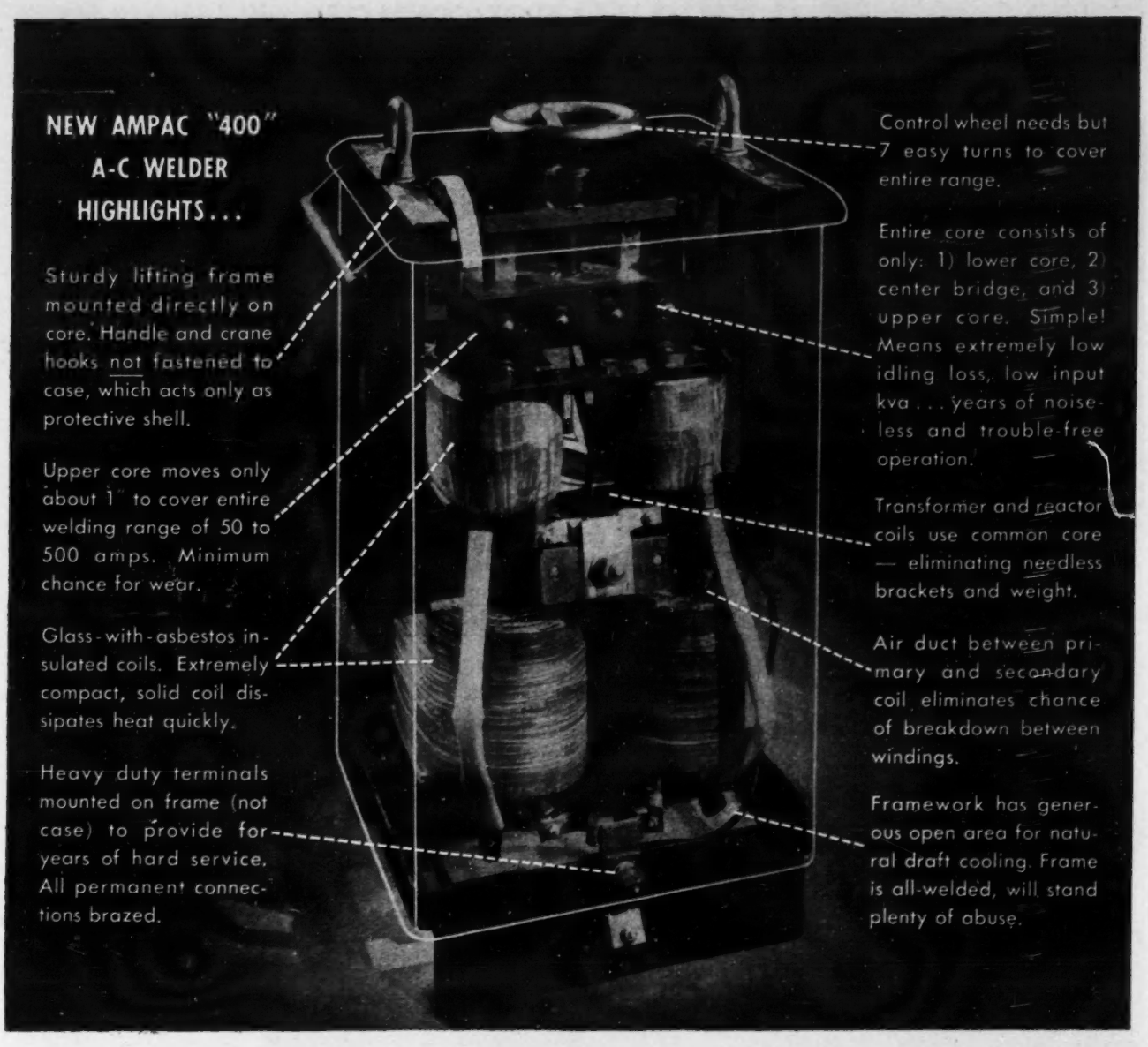
The Check List

- CONDUCTOR SUPPORTS CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- AIR BREAK SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED ISOLATED PHASE HEAVY DUTY BUSES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SECTIONALIZING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES

RAILWAY AND INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.

IN CANADA—EASTERN POWER DEVICES, LIMITED, TORONTO

PRODUCT OF THE MONTH


NEW AMPAC "400" A-C WELDER HIGHLIGHTS...
Sturdy lifting frame mounted directly on core. Handle and crane hooks not fastened to case, which acts only as protective shell.
Upper core moves only about 1" to cover entire welding range of 50 to 500 amps. Minimum chance for wear.
Glass-with-asbestos insulated coils. Extremely compact, solid coil dissipates heat quickly.
Heavy duty terminals mounted on frame (not case) to provide for years of hard service. All permanent connections brazed.
Control wheel needs but 7 easy turns to cover entire range.
Entire core consists of only: 1) lower core, 2) center bridge, and 3) upper core. Simple! Means extremely low idling loss, low input kva . . . years of noiseless and trouble-free operation.
Transformer and reactor coils use common core — eliminating needless brackets and weight.
Air duct between primary and secondary coil eliminates chance of breakdown between windings.
Framework has generous open area for natural draft cooling. Frame is all-welded, will stand plenty of abuse.

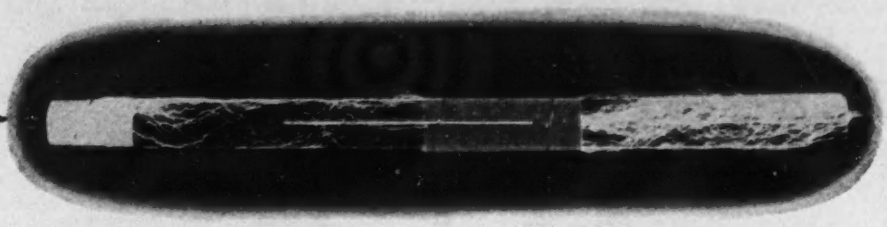
MILWAUKEE, WIS.—Allis-Chalmers announces the new Ampac "400" a-c welder...engineered and built during war to meet 24-hour-day requirements. It employs the simplest possible construction of a continuously variable welder—is exceptionally efficient and rugged. Send for Bulletin B-6302.

A 166

WE WORK FOR VICTORY · WE PLAN FOR PEACE

ALLIS-CHALMERS · MILWAUKEE · WISCONSIN

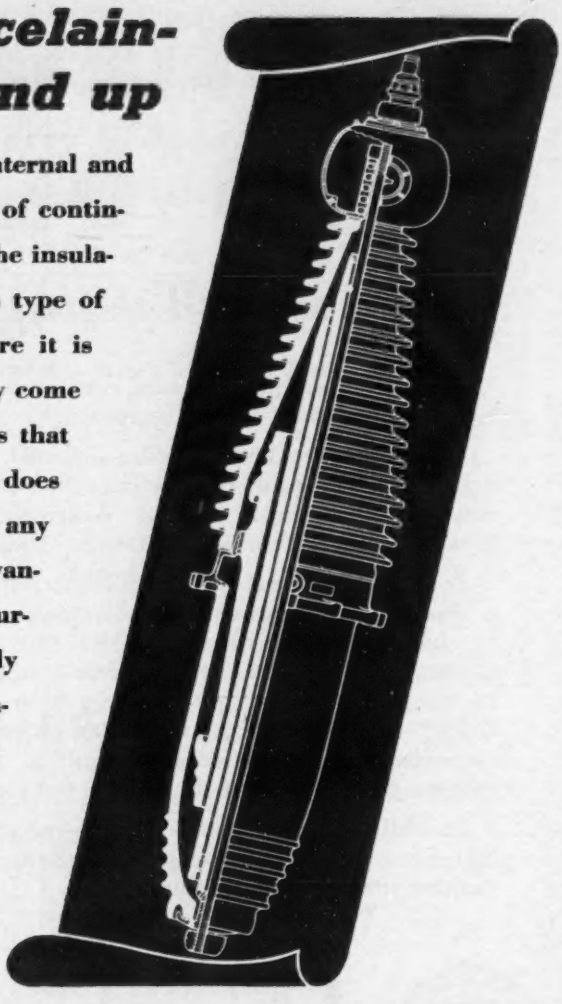
BECAUSE YOU CAN'T HURT PORCELAIN



Each porcelain component of an O-B bushing receives a prolonged flashover test to prove its soundness. This kind of insulating material, and the type of testing it gets, is the best assurance of trouble-free performance.

YOU CAN REALLY *TEST* IT!

..That's why O-B porcelain-insulated bushings stand up



When you get a new O-B bushing, every separate internal and external porcelain part has withstood three minutes of continuous flashover at 60 cycles, without having harmed the insulation to the slightest degree. Porcelain can take this type of testing that positively establishes its soundness before it is used. Porcelain can take any service conditions that may come along later. Flashovers cannot produce carbonized paths that lead to eventual failure. Moisture or condition of the oil does not affect the porcelain. Time hasn't changed porcelain in any way in hundreds of years... Because of the inherent advantages of porcelain as a bushing insulation, you have the assurance that it is good to start with; that it has been most severely tested to prove this fact; and that it will stay that way indefinitely! The only way you can get this rugged porcelain internal insulation is by specifying O-B bushings on your apparatus.

2412-H

Ohio Brass

MANSFIELD, OHIO

CANADIAN OHIO BRASS COMPANY, LTD., NIAGARA FALLS, ONTARIO

KEEP BUYING WAR BONDS

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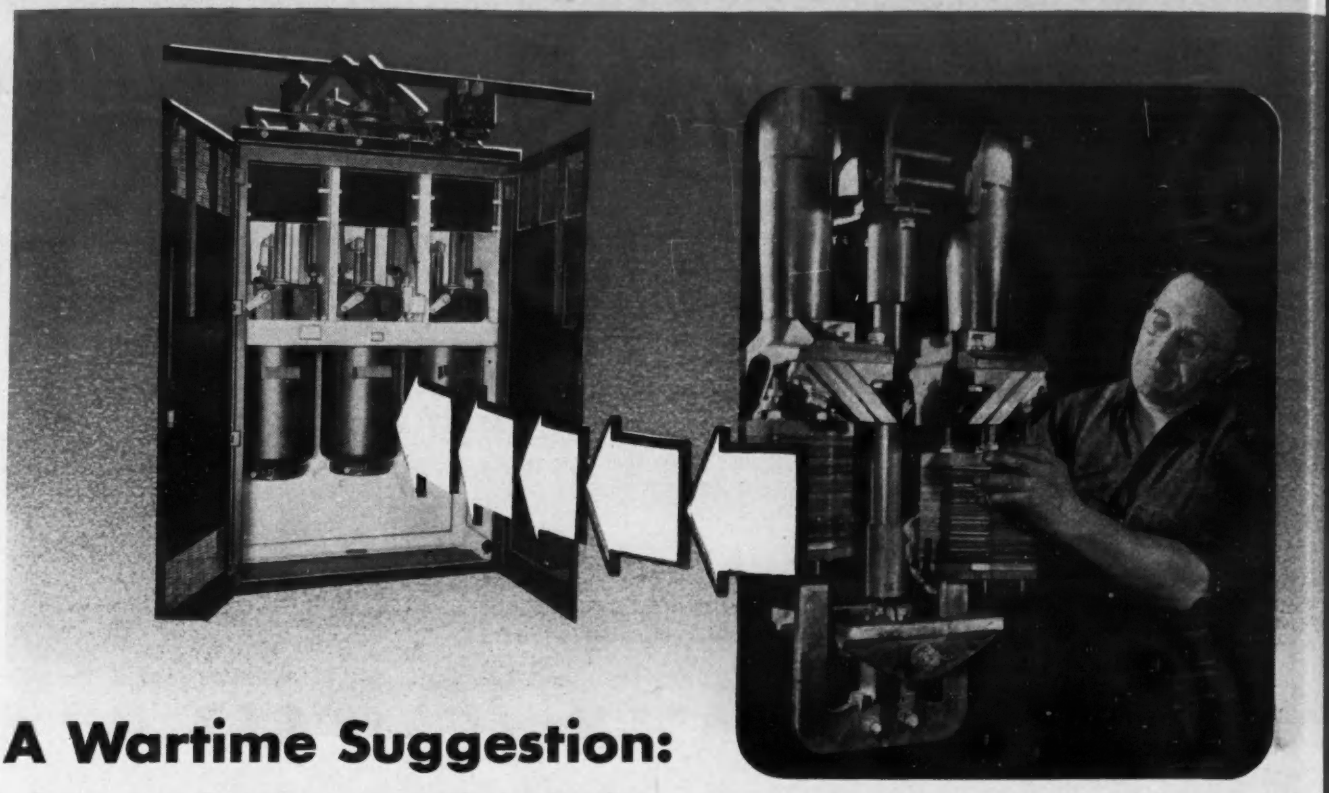


A Wartime Suggestion:

when new breakers can't be bought . . .

ADD NEW LIFE TO OLD BREAKERS

with Westinghouse "De-ion Grids"

As system loads grow greater, breaker interrupting capacities must also be increased.

Where new breakers can't be obtained to meet such needs, a time and cost-saving solution in some cases, is to rebuild existing Westinghouse oil breakers to include modern "De-ion Grids".

For example, one Southern utility recently found it necessary to improve the performance of some of their indoor breakers to take care of war-expanded loads. New breakers were unobtainable. So they modernized the breakers with "De-ion Grids" . . . gave them a new lease on life. Their capacities were increased as a result of increased efficiency . . . critical materials were saved.

In addition, system stability was improved . . . faster arc extinction greatly reduced the need for breaker inspection and maintenance.

Investigate the possibilities of modernizing your present Westinghouse oil circuit breakers with "De-ion Grids". Westinghouse engineers will gladly consult with you . . . give you the benefit of their knowledge and experience. Write Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

WHAT "DE-ION GRIDS" CAN DO

RENEW BREAKER LIFE. Add years of service.

INCREASE SYSTEM STABILITY. High-speed opening of the circuit shortens fault time; greatly reduces system disturbances.

REDUCE OIL DETERIORATION and contact burning. With faster arc extinction, you can increase periods between oil conditioning, contact inspection and dressing.

INCREASE BREAKER CAPACITY. Modern, quick-quenching "De-ion Grids" speed opening action, may permit handling heavier loads with greater safety. J-60538

Westinghouse "De-ion Grids"

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

VARNISHED CAMBRIC · RUBBER POWER CABLES · BUILDING WIRE · RADIO WIRES · SIGNAL CABLE · FLEXIBLE CORDS · LEAD-ENCASED AND PARKWAY CABLES · ARMORED CABLE · CRESFLEX NON-METALLIC SHEATHED CABLE · SERVICE ENTRANCE CABLE · MAGNET WIRE · BARE WIRE

You'll Find **SAFETY** *and* **SATISFACTION**

in these

CRESCENT

Building Wires and Cables

CRESCENT *Building Wire*

Under latest government regulations, no crude rubber is used in the manufacture of these wires, yet through the substitution of plentiful Buna S Synthetic Rubber they retain the inherently superior moisture-resistant, long-life properties of rubber insulation. They carry Underwriters' Laboratory labels, and are approved under the National Electrical Code for *all interior wiring systems,* and are the most available wires in wholesalers' hands at present and for the duration.

WAR PRODUCTION 100%

"CRESFLEX" *Non-Metallic Sheathed Cable*

CRESCENT INSULATED WIRE & CABLE CO.

CRESCENT

WIRE and CABLE

Factory: TRENTON, N. J.—*Stocks in Principal Cities*

CRESCENT ENDURITE SUPER-AGING INSULATION · WEATHER-PROOF WIRE

SYMBOLIC
THE TRADE MARKS OF
INDUSTRIAL AMERICA,
the monogram of Elliott Company typifies the engineering skill and productive capacity which is casting the shadow of defeat over Axis aspirations.
ONE OF AMERICA'S GREAT BUILDERS

total eclipse approaches

The war is now feeling the weight of one irresistible factor—the combined might of American manufacturers, whose thousands of production lines are disgorging the implements of mechanized battle in a volume almost unbelievable. *The trade marks of America are on the march.*

Every one of these thousands of trade marks represents a standard and type of engineering ingenuity peculiarly American, applied with an understanding of volume production and its possibilities far beyond that of any other people on earth. Each of them is the proud mark of successful individual enterprise, which here in America has come to its fullest fruition. *The trade marks of America are in the fight.*

The Axis powers do not know Production as we know it, nor did they realize the potentialities of American industrial organizations. Else they would not have chosen to start a mechanized war against, of all people, the nation which first introduced volume manufacturing, and whose mechanical ingenuity is supreme. The Axis lost the war at Pearl Harbor, unleashing for their own ultimate destruction the mighty forces of American individual enterprise. *The trade marks of America spell doom for the Axis.*

We believe the unified might of American management, American engineering, American labor, and notably of American individual enterprise, provides the most powerful single factor in the favorable course of the war, and that history will so record it. *The trade marks of America are winning the war.*

Elliott Company is one of those large manufacturing organizations whose products are of a basic type, equally vital and necessary in peace as in war. Elliott power equipment and Elliott process apparatus are today battling toward victory ashore and afloat, just as they will be working to produce the essentials of the greatly expanded scheme of living which will follow the day of victory.

STEAM TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • SUPERCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTERS

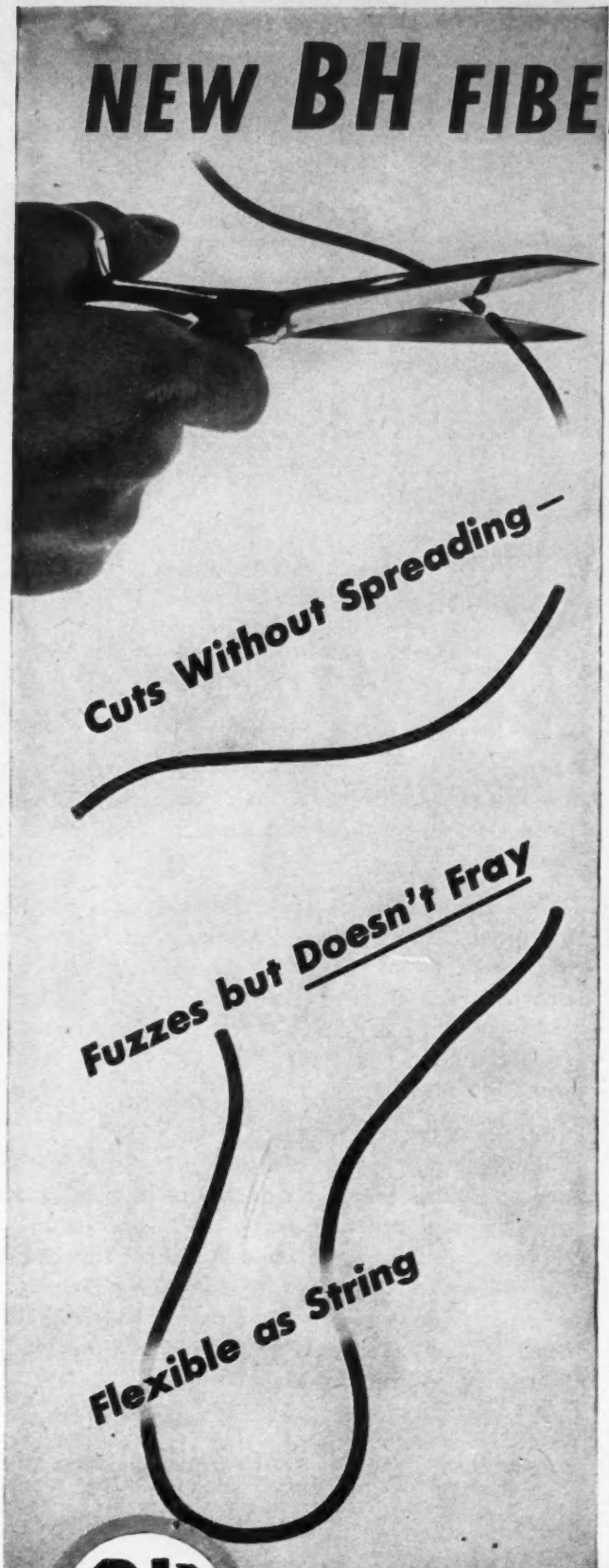
ELLIOTT Company

JEANNETTE, PA. • RIDGWAY, PA. • SPRINGFIELD, OHIO
DISTRICT OFFICES IN PRINCIPAL CITIES

D-1086

POWER AND PROCESS EQUIPMENT

NEW BH FIBERGLAS SLEEVING



You've waited a long time for a sleeving that was *both* flexible and non-fraying. Now it's here—BH Extra Flexible Fiberglas Sleeving.

As an example of the hundreds of uses for this new product, let's look at a typical brush shunt job. Sleeving for this application should be flexible. When cut to length, the ends should not fray or spread. Formerly, brush manufacturers stiffened the ends of the sleeving to prevent fraying and also to facilitate threading onto the pigtail. BH Extra Flexible Fiberglas cuts cleanly without spreading, eliminates the extra dipping operation. Furthermore, in service the ends do not fray. Constant vibration produces only the slightest fuzz. Yet even these are but a few advantages of this new sleeving.

NON-FRAYING • FLEXIBLE • HEAT-RESISTANT
NON-INFLAMMABLE • WATER-RESISTANT
NON-CRYSTALLIZING at LOW TEMPERATURES

The new BH Extra Flexible Fiberglas Sleeving is woven from the choicest continuous-filament Fiberglas yarns. It possesses high dielectric strength, is water-resistant and, like all BH Sleeving and Tubing—is non-inflammable.

All sizes, from No. 20 to 5/8", inclusive, are available. Write for samples of this radically new and different sleeving today—in the sizes you desire. Seeing is believing! Bentley, Harris Manufacturing Co., Dept. W, Conshohocken, Pa.

BH PRODUCTS

NON-BURNING IMPREGNATED MAGNETO TUBING • NON-BURNING FLEXIBLE VARNISHED TUBING • SATURATED AND NON-SATURATED SLEEVING

BENTLEY, HARRIS MANUFACTURING CO.
Conshohocken, Penna.

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

HOW TO SOLVE

Operating Problems with *Correct Lubrication*

Keep This Ring Turning!

PROBLEM: An important step in securing the dependable performance built into your electric motors is to make sure they have *correct lubrication.*

Ring-oiled bearings like the one above must always operate with a sufficient supply of oil to protect them from trouble-causing wear. That means the ring must not stick. It must continuously turn and pick up oil and deliver it to the bearing.

ANSWER: You need an oil here that has enough *body* to be picked up by the ring as it turns, but it must be *light* enough not to retard it. Furthermore, the oil must *resist the formation of deposits* that might make the ring stick.

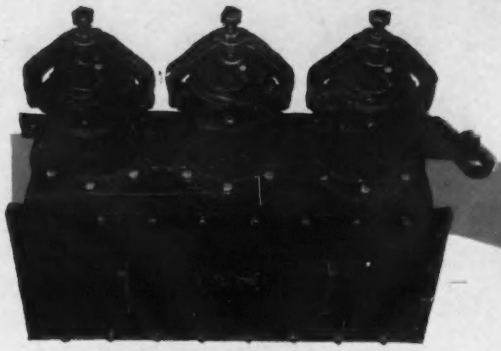
• • •

You'll find there is a Gargoyle Oil with these properties which will help assure you dependable, low-cost electric motor operation with a minimum amount of time needed for maintenance.

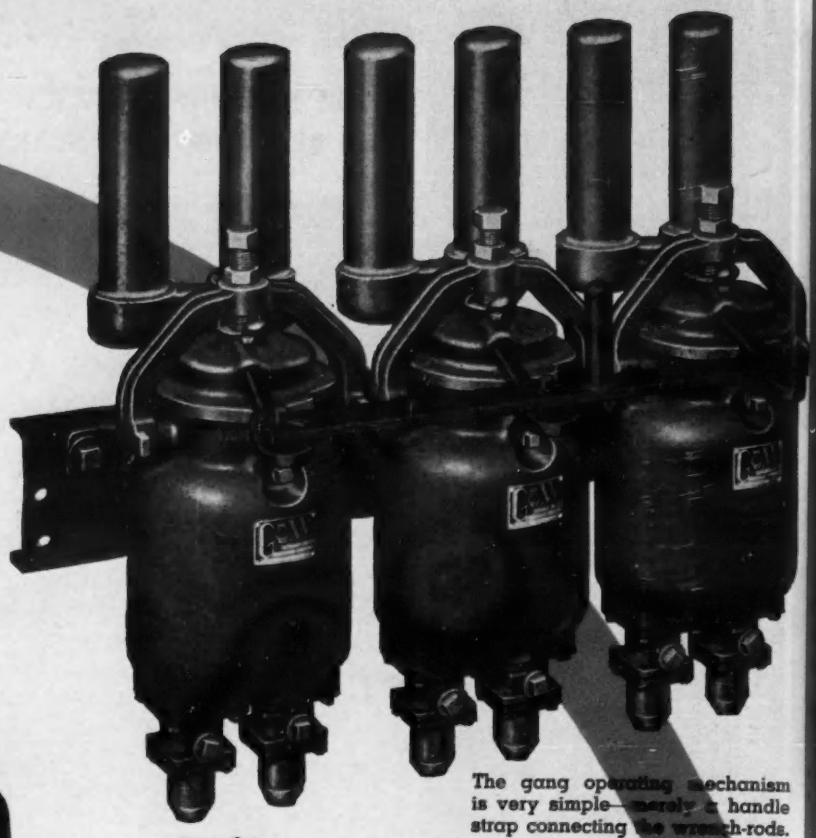
GARGOYLE Lubricants

SOCONY-VACUUM OIL COMPANY, INC. — Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. White Eagle Div. • Wadhams Div. • Magnolia Petroleum Company • General Petroleum Corporation of California

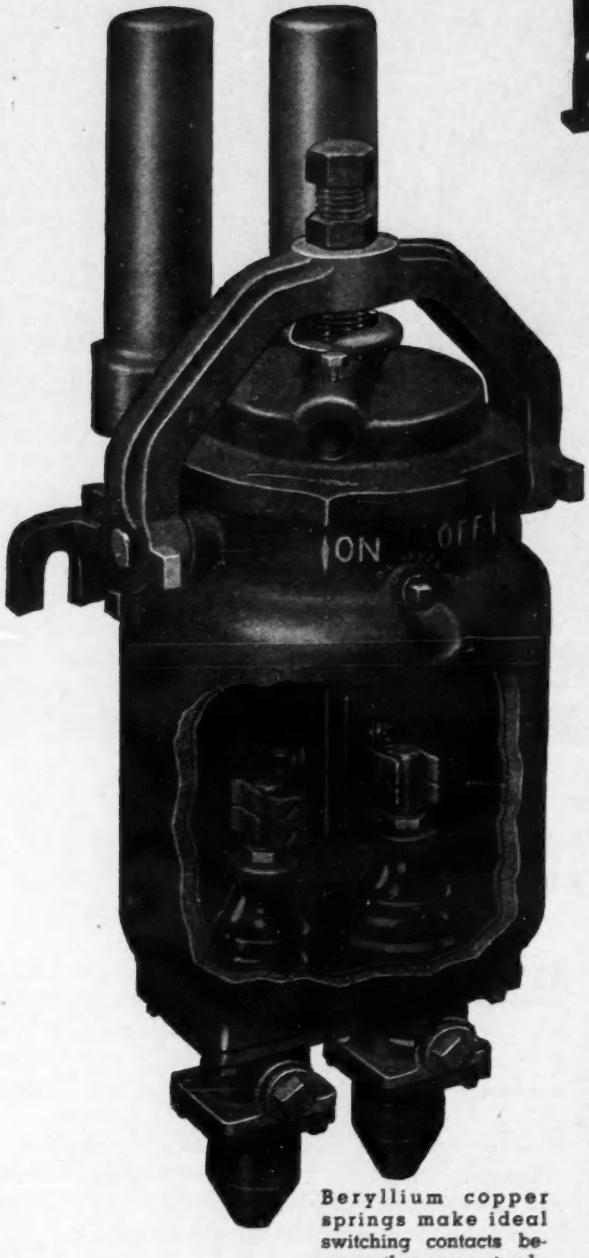
CALL IN SOCONY-VACUUM



Type "FCBX" fuse-switch boxes provide full metal enclosure of connections. Necessary cable and conduit fittings are attached to the welded steel box.



The gang operating mechanism is very simple—merely a handle strap connecting the wrench-rods.



Beryllium copper springs make ideal switching contacts because they are not subject to fatigue.

use

G&W Type "FC"

Gang-Operated

OIL FUSE CUTOUTS

FOR FUSING OR SWITCHING PRIMARY CIRCUITS IN SUBWAY, VAULT AND OVERHEAD INSTALLATIONS

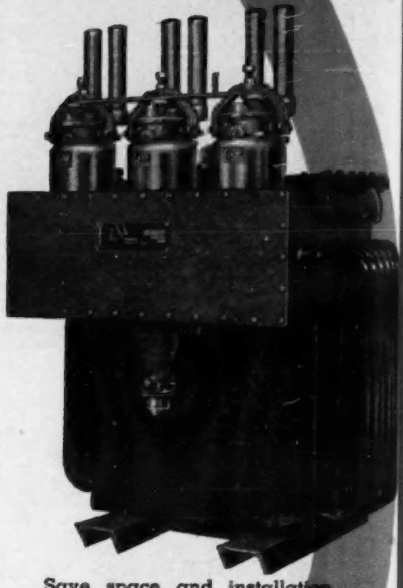
The years of trouble-free service has created a wide acceptance of G & W Type "FC" Oil Fuse Cutouts. The modern design provides interchangeability of parts for various installation conditions. The interlocking cover and cover clamp insures safety in fuse replacement. The simple and inexpensive fuse link universally fits all Type "FC" cutouts.

Ratings—

2500 volts to ground, 100 amperes. 30000 Kva. 3 phase interrupting capacity.

5000 volts to ground, 200 amperes. 50000 Kva. 3 phase interrupting capacity.

Send for Bulletin No. 425



Save space and installation labor by combining G & W Type "FCBX" fuse-switch boxes with transformers.

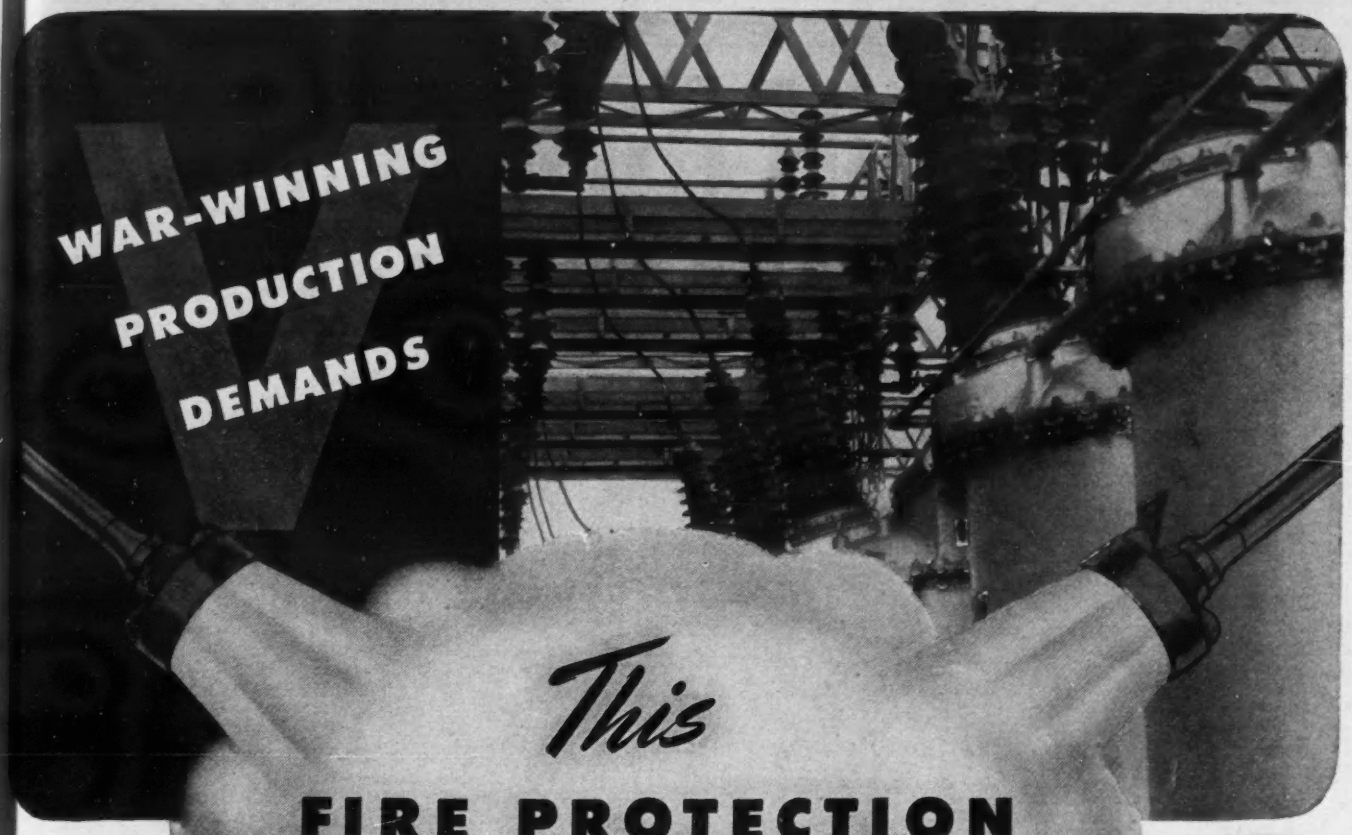
G&W ELECTRIC SPECIALTY COMPANY

7780 DANTE AVENUE — CHICAGO, ILLINOIS

IN CANADA—POWERLITE DEVICES, LTD., TORONTO

G&W ELECTRIC CABLE DEVICES

POTHEADS . . . BOXES . . . OIL FUSE CUTOUTS . . . OIL SWITCHES AND MULTIPLE CIRCUIT OIL DISCONNECTS



This FIRE PROTECTION

by CARDOX Fire Extinguishing Systems

More war goods from fewer man-hours is one of America's most urgent needs today! Every hour saved here is another step toward victory.

One major fire—or a small fire that results in crippling damage by the extinguishing medium—can cut the flow of vital war goods to a trickle over night. Such fires may halt or slow down production on a dozen essential fighting tools . . . waste precious man-hours and critical materials.

Cardox Fire Extinguishing Systems provide distinctive advantages in protecting production against these war-prolonging fires. They smother the fire and "cool out" combustibles through timed mass discharges of *pounds* or *tons* of CO_2 . . . with no damage by the extinguishing medium. Consequently, when fire strikes, men and machines are usually back in production quickly. Losses of vital materials are reduced to a minimum.

Industries guarding War-Winning Production with engineered Cardox Fire Extinguishing Systems include leading manufacturers of *Airplanes, Airplane Parts, Armor Plate, Aviation Carburetors, Aviation Engines, Cold Strip Steel, Electric Power, Engine Parts, Forgings, Motor Fuel, Plastics, Processed Fabric, Rubber Products, Solvents, Tanks, Tank Engines.*

Today, the facilities of Cardox are concentrated on two activities: (1) Providing fire protection for War-Winning Production; (2) Applying the technological knowledge gained here to help industrial, municipal, state and national fire fighting organizations perfect plans to increase the efficiency of fire protection both today and after the war.

If more information would help—in solving your fire protection problems of today or tomorrow—write on your company letterhead for Bulletin 5103.

★ ★ ★

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS

District Offices in New York • Washington
Detroit • Cleveland • Atlanta • Pittsburgh
San Francisco • Los Angeles • Seattle

How Cardox Systems Protect War Industries

- Timed discharges, as needed, through built-in piping systems . . . supplied instantly from a single storage unit holding tons (if required) of liquid Cardox CO_2.
- Mass discharge of Cardox CO_2 "knocks out" fire, by . . .
- Reducing oxygen content of the atmosphere below the concentration necessary for combustion, and . . .
- Cooling combustibles and fire zone below ignition temperature . . .
- Extinguishing fire quickly and completely *without* damage from extinguishing medium.

CARDOX—CO_2 Systems with Enhanced Fire Extinguishing Performance

A. Uniformity of CO_2 characteristics.
B. Extinguishing medium with uniformly greater cooling effect.
C. Accurate projection of CO_2 through greater distances.
D. Timed discharges, as needed, through built-in piping systems . . . supplied quickly from a single tank holding tons of liquid Cardox CO_2.

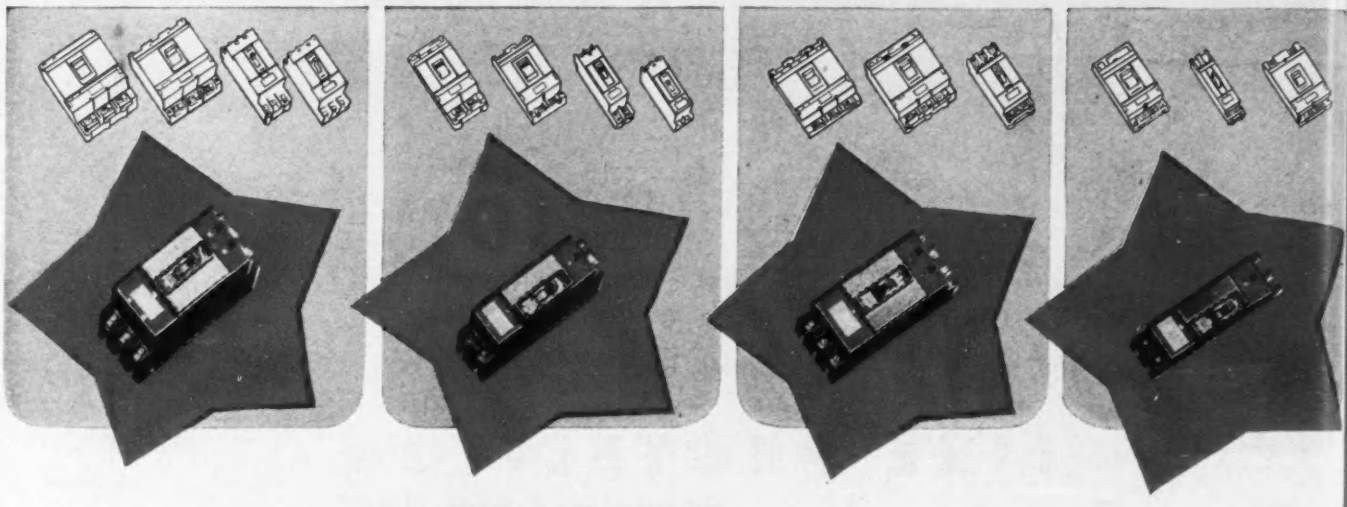
MASS DISCHARGE OF CO_2 · ENHANCED COOLING EFFECT · CENTRAL STORAGE UNIT · AMPLE CO_2 RESERVE · ENGINEERED SYSTEMS · MANUAL OR AUTOMATIC CONTROL

CARDOX

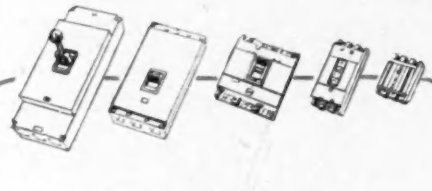
NON-DAMAGING FIRE EXTINGUISHING SYSTEMS

mobilized FOR WAR

4 breakers TAKE THE PLACE OF 14



——TO SAVE 18% COPPER
——TO SAVE 38% STEEL
——TO CONSERVE SPACE
——TO IMPROVE CIRCUIT PROTECTION



Nofuze "De-ion" Breakers

—prevent *harmless* overloads from interrupting war production.

—protect circuits from *dangerous* overloads and "shorts."

—restore service *instantly* with just a flip of the switch.

As a voluntary war measure, Westinghouse has "mobilized" the Nofuze line of "De-ion" Breakers. For example, all ratings from 15 to 100 amperes have been made available in one compact frame size. Instead of 14 models, 4 now serve the same purpose. Pole spacing and terminal arrangements have been made standard for interchangeability. Space is saved—vital materials are conserved.

Today, the production of Nofuze Breakers is concentrated on war requirements. Our engineering facilities are serving all branches of the war effort on a broad consulting basis.

Result: many far-reaching developments are being made . . . overload protection of low-voltage circuits has been greatly improved. If you have a war circuit problem, ask your Westinghouse representative for engineering help. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N. J-60523

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

NOFUZE CIRCUIT PROTECTION

Free Enterprise

WE MUST ACT TO PRESERVE IT!

☆

LIKE a leaf floating downstream, we are being carried along toward a new and uncharted economy. What this new economy will be like will depend, to no small extent, upon what industry does or fails to do during the coming months. Time is short; in fact, we may suddenly find ourselves standing on the threshold of a peace economy with our war boots still on our feet.

While bending every effort to win the war, we cannot afford to be caught unprepared for the peace. As Prime Minister Churchill said at Harvard, we are "bound, so far as life and strength allow and without prejudice to our dominating military task, to look ahead to those days which will surely come, when we shall have finally beaten down Satan under our feet and find ourselves with other great Allies at once the masters and the servants of the future." Unless we do look ahead, there is danger that we may become neither the masters nor the servants, but merely the victims, of the future.

The war has quickened our ailing economy and opened our eyes again to the possibilities of peace-time plenty. But it has also brought great dislocations of labor and capital; it has led to abnormal patterns in prices and income distribution; and it has created inflationary pressures with enormous potential powers to injure or to help us in the transition from war to peace.

The pattern of life in postwar America will be just what we make it. All of us will have a hand in shaping that pattern, but business men will have a special responsibility in the reconstruction. As employers of labor and capital and as enterprisers assuming the risks of new ventures, they will have to plan and carry out the conversion from war work to full peace-time production. Because of their key role, business men have a special opportunity to discover, and to help others to understand, the conditions which are necessary if they are to do their job satisfactorily.

This is a narrow view of postwar problems but it is a central view, because no one condition is more vital to the health of the world than a high level of production and employment in the United States. We cannot hope to lead the world out of economic chaos if we fail to put our own house in order. If we fail to adjust our domestic economy, we may destroy Adolf Hitler; but we will not destroy the germ that breeds "Hitlers." If we do not maintain the production necessary for supporting a large volume of imports and exports, then the plans for international monetary stabilization, for good relations with our neighbors, for rehabilitation of stricken countries, and for strengthening the democratic bulwarks against dictatorship are all likely to come to grief. We must demonstrate our capacity for world leadership, or be content to follow the leadership of others.

The prospects for achieving a sound and vigorous economy in the United States are not so good as to warrant complacency on the part of men genuinely interested in free enterprise and the political freedoms incident to it. We have yet to find means to utilize our vast and abundant resources for the good of all. We have yet to learn how to keep men from the terrible experience of unemployment and the fear of want which makes them willing to sacrifice freedom and opportunity for almost any promise of security. We have yet to reconcile the conflicting interests of labor, agriculture, and business so that they can work together effectively. We have yet to learn how to check the fever of inflation and cure the palsy of depression.

When we were attacked at Pearl Harbor, we realized our physical peril immediately and united in a tremendous common effort against the enemy. The onset of economic perils is less obvious. No bombs will signal the deterioration of the private enterprise system, the extension of regimentation, the further control of busi-

ness by government, and the concentration of political power in less and less responsible hands. If these things should befall us, they will come insidiously while we are preoccupied with self interests and oriented by popular misconceptions. If the freedoms of the individual shrivel as the state grows in power, it will be because the individual is too indifferent or complacent to concern himself seriously with economic problems. If our people are misled by false prophets and demagogues, it will be because business men did not understand economics, because scholars were too ignorant of practical affairs, and because we failed to produce economic statesmen of sufficient stature for the task in hand.

Thinking is hard work. Thinking about things outside our personal experience, about economic processes that are broader and in some fundamental respects different from buying and selling or running a business – is strenuous mental labor. Thinking straight about problems that are beyond our personal and immediate status and our pocketbooks, thinking about problems that involve nation-wide production, nation-wide employment and nation-wide buying power – in other words the operation of our entire economic system – involves real self-discipline. Yet there is no other way to safeguard our freedoms. We cannot rely on trial and error; tinkering takes too long; social experiments which turn out wrong can be undone only at great cost – if at all. If we proceed blindly, we shall flounder into an economic and political morass from which we cannot escape.

We floundered badly all through the Thirties, until the war lifted us temporarily to higher ground. When the war boom is over, we shall be back floundering worse than ever unless we find a solid road along which to proceed.

America has grown rich and strong under a system of political and economic freedom. Opportunity and the necessity of self-reliance have brought forth great accomplishments. The hope of profit and the spur of competition have urged men on to find new and better products, new and better methods, and to risk their savings in pioneer investment. Never has a country achieved so high a standard of living and afforded so large an opportunity for the individual man and woman. It is not surprising that some distinguished business leaders, looking back over their own experience, tell us that everything will be all right if only there is "less government in business."

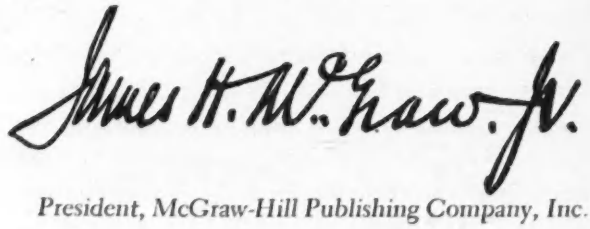
I wish the solution were as simple as that. However this is only part of the answer. It is becoming increasingly clear that industrial capitalism as we know it contains within itself certain fundamental weaknesses which can lead to its destruction if they are not counteracted. No democracy can survive when twenty to thirty per cent of its workers cannot get jobs. That happened here in the Thirties. For years on end, despite fumbling efforts at recovery one out of every five workers was denied a chance to earn a living in private business. We shall never again have such mass unemployment as occurred in the bottom of the Depression, because the government will take it upon itself to create jobs if business cannot offer them. Whenever that happens, however, the area of private enterprise will be reduced and that of government will be expanded – and the concentration of political power will be increased. This is the challenge we business men face today, and ours is the first opportunity at finding the solution.

The crux of our economic problem is unemployment. Unless there are jobs for ninety to ninety-five per cent of those who are able and willing to work, there will be widespread fear and lack of opportunity, which will drive labor unions, agricultural groups, and business interests to take self-protective measures. Such measures are certain to restrict production, stifle progress, and imperil our democratic way of life. Not all our problems will automatically be solved if we learn how to avoid mass unemployment, but they will at least then have a good chance of solution.

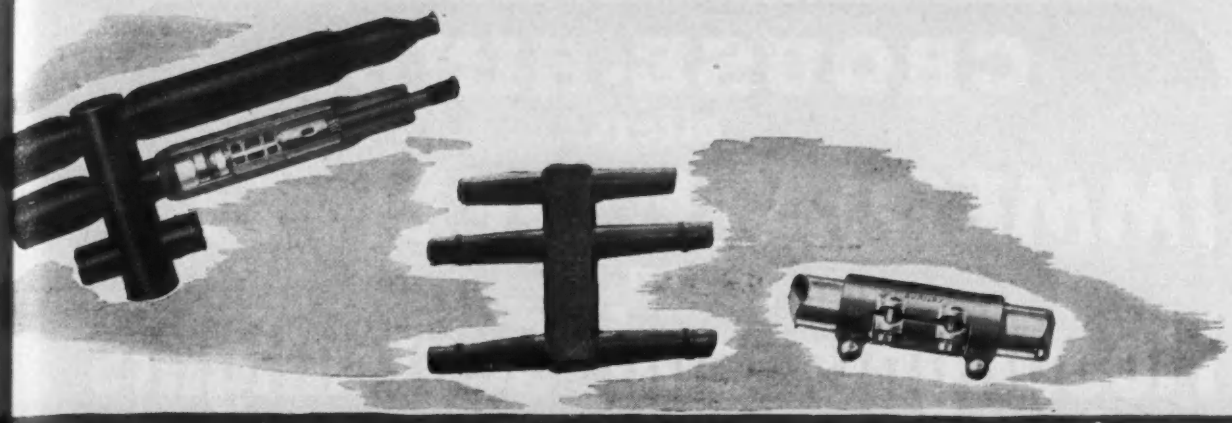
And so American businessmen face a great responsibility! We will have to find the answer to a great many momentous questions. We will have to delve into problems that cannot be solved by precedent.

Looking backward to these times, future historians are likely to say that here we Americans stood at the crossroads and, consciously or not, made our choice between a system of private enterprise and personal freedom and a system of collectivism and regimentation.

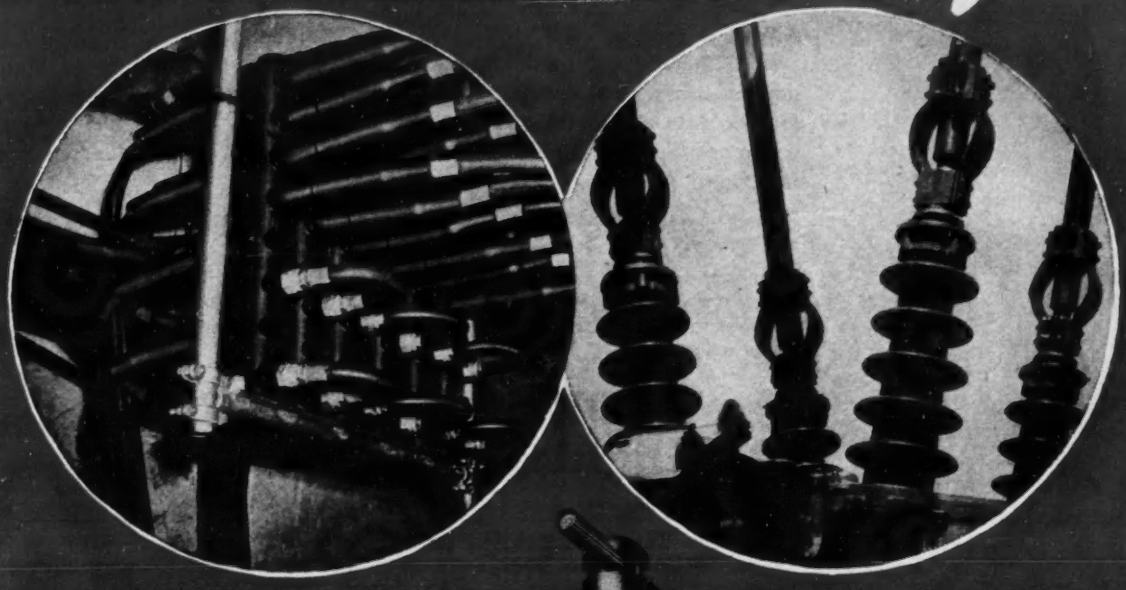
It is particularly appropriate, therefore, as the problems of our time take shape and as events rearrange their order and importance, to appraise the steps we are taking and point the way we are going. It is my plan to present such analyses from time to time to the one-and-a-half million readers of McGraw-Hill publications.



President, McGraw-Hill Publishing Company, Inc.



WE'VE KEPT THE FUNDAMENTAL JOB *in focus!*



BURNDY'S *leadership* in electrical connectors now covers the aviation, marine and all other war industries . . . thanks to years of pioneering with the utilities in the development of connectors for all utility requirements. But even under the pressure of turning out connectors *literally by the millions* for war needs, Burndy's thoughts and engineering planning have remained focused on the years ahead. For the backbone of the great electrical era coming will be the utility . . . and headquarters for utility connector requirements will remain here . . . at Burndy.

UTILITY
Headquarters for connectors

BURNDY
ELECTRICAL CONNECTORS

OVERHEAD • UNDERGROUND • POWER • WIRING • GROUNDING

BURNDY ENGINEERING CO., INC. • 107 EASTERN BOULEVARD, NEW YORK 54, N. Y.
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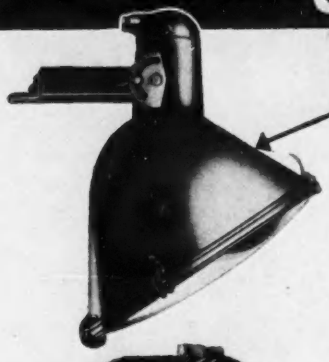
CROUSE-HINDS
offers
IMMEDIATE DELIVERY
on
Floodlights and Searchlights

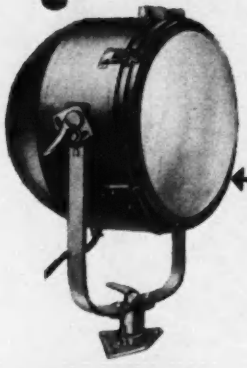


Type MUA, Light Duty Floodlights

● Easy to service. ● Weatherproof. ● Cast Feraloy socket housing, (semi-steel). ● Reflector. Porcelain enameled steel. ● Lens. Clear or stippled heat-resisting glass. ● 750, 1000 or 1500-watt lamps. ● Degree markings for accurate horizontal and vertical setting of floodlights. ● 4 Mountings. Cross arm bracket, pipe slip filter, wood pole or wall bracket, and vertical or horizontal U-bolt pipe clamp.

Type MUA can be furnished as an open floodlight. The weatherproof door can be added at any time.

Other light duty floodlights that can be shipped promptly are Type MUB in the 200, 500 and 1000-watt sizes; Type MUA Elliptalux and Type MUA Multalux. MUA floodlights can be furnished with an auxiliary reflector that concentrates part of the light into a narrow beam for longer range.



Type ADE-14 Heavy Duty Floodlights

● A high efficiency unit. Medium and long range. ● Weatherproof sheet steel housing. ● 14-inch crystal mirrored-glass reflector, narrow or wide beam. ● Lens. Clear heat-resisting glass. 50° spread, 100° spread or diffusing lens. ● 500-watt lamp. ● 4 Bases. Standard, pipe slip fitter, single bolt, and U-bolt pipe clamp.

Prompt shipment can also be made on other sizes of heavy duty floodlights; Types ADE-12, ADE-16, LCE-1120, LCE-24; ADR-12 and ADR-14 portable floodlights; RCD-8 special vaportight and RCDE-8 special explosion-proof floodlights.

Type DCX-18 Searchlights

● Long range. ● Pedestal mounting with ball bearings and pilot house lever control. ● Weatherproof steel housing, reinforced at load points by Feraloy castings. ● Accurate silvered-glass reflector. ● Lens. One-piece, heat and impact-resisting plate glass. ● 420 to 2000-watt lamps.

Type DCE-18 searchlights with fixed mounting base and Type DCY-18 with ball-bearing pedestal base for hand directing are also available. Crouse-Hinds complete line of searchlights includes 8, 12, 18 and 24-inch sizes.

Crouse-Hinds is prepared to build special lighting equipment for war applications.

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
SYRACUSE, N. Y., U.S.A.

Offices: Birmingham — Boston — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington

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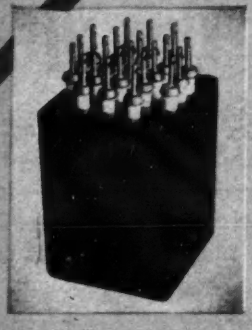
CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

When will war production End?

Excerpt from "A Special Report on America's Industrial Future" by The Research Institute of America.

"At the end of the twelve-month period (July 1944), large areas of slowing down and actual cessation in war manufacture will be appearing. This will be a critical period for many companies . . . IT IS THE PERIOD TOWARD WHICH EXECUTIVE THINKING AND PLANNING SHOULD NOW BE DIRECTED"



HERMETICALLY SEALED TRANSFORMERS

Gas filled or high vacuum impregnated. Built to withstand high altitudes and tropical use. Modern case design in standard sizes.

Other products manufactured include:

ELECTRONIC CONTROLS • VACUUM TUBES OF STANDARD AND SPECIAL TYPES • HYDRAULIC SERVOS ELECTROMECHANICAL DEVICES

● Of this you can be sure: Many business and industrial organizations are losing no time in preparing for a head-start in the competitive postwar market. They are planning and designing new ways to make better products, faster and cheaper . . . through the use of Electronics.

For assistance in *your* planning, General Electronics Industries offers the research engineering skill and specialized experience that have met the exacting tests of war with great achievements in the fields of *Electronics, Hydraulics* and *Electromechanics.* And further, General Electronics Industries has the facilities, equipment and personnel to meet your requirements with speed and efficiency.

Write to Engineering Department, General Electronics Industries, 342 West Putnam Avenue, Greenwich, Connecticut.

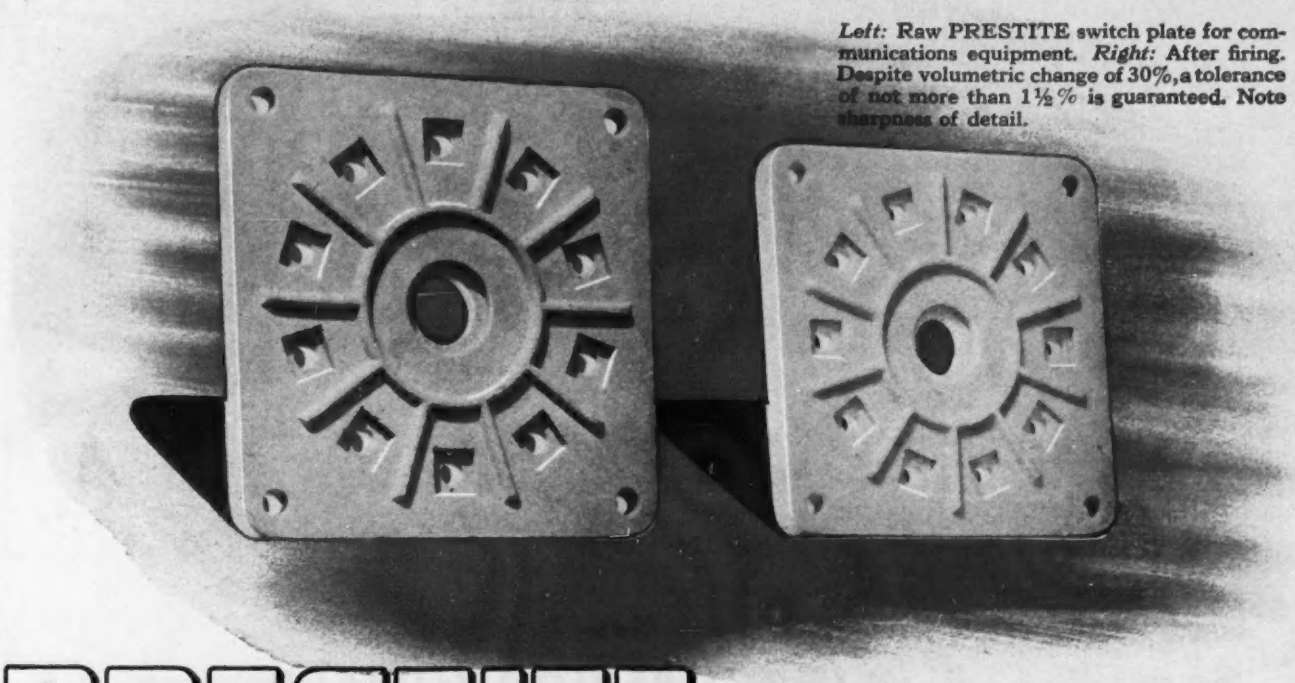
rmy-Navy "E" with Star, awarded to uto-Ordnance Corporation for continued xcellence in production of "Tommy" Guns

GENERAL Electronics INDUSTRIES

Division of Auto-Ordnance Corporation

REENWICH • STAMFORD • BRIDGEPORT • NEW YORK

A NEW ABUNDANT REPLACEMENT FOR CRITICAL MATERIAL



Left: Raw PRESTITE switch plate for communications equipment. *Right:* After firing. Despite volumetric change of 30%, a tolerance of not more than 1½% is guaranteed. Note sharpness of detail.

PRESTITE—the new pressure-molded ceramic—can be molded to CLOSE TOLERANCES

PRESTITE parts ranging from simple, tiny bushings to large complicated shapes (up to 120 square inches, projected area) are being mass-produced to a *Westinghouse-guaranteed tolerance of* 1½% *or less.* In some cases, tolerances of 1% are being attained. Where extremely close fit or precision is required, close-tolerance molding of **PRESTITE** parts can be supplemented by machining before, or grinding after, firing.

As a result, product designers are turning to **PRESTITE** as a replacement material for parts requiring a degree of precision not commonly associated with ceramics. **PRESTITE** also offers other basic benefits. For example: it rivals alloy steel in compressive strength... is as light as aluminum... isn't fazed by heat up to 800° C... is impervious to moisture and chemicals except hydrofluoric acid. It is easily worked... can be cored for intricate internal cavities—and mass-produced.

It is replacing other materials—in many cases, permanently—for high-speed pump valve seats, sand blast nozzles, bus supports, brackets and many other products. Where parts are subjected to arcing, as in ignition distributors and cable sleeves, non-carbonizing **PRESTITE** provides a superior replacement for organic materials.

If these qualities and applications suggest a possible answer to your product-problem, we'll be glad to help you solve it.

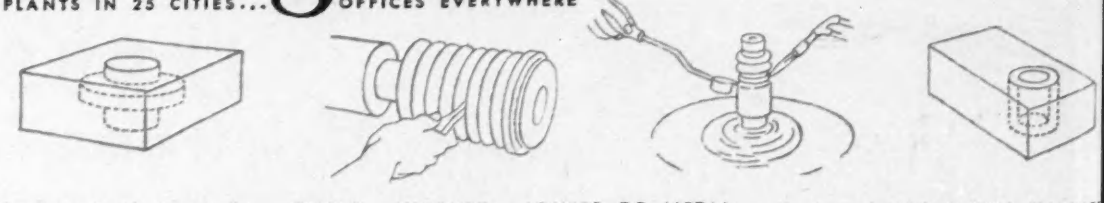
★ ★ ★

GET THE FACTS ABOUT PRESTITE. New **PRESTITE** Book shows applications in many fields... presents technical working data for designers... design suggestions and limitations... charts and test results. Write today, for B-3121, "Facts about PRESTITE". Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

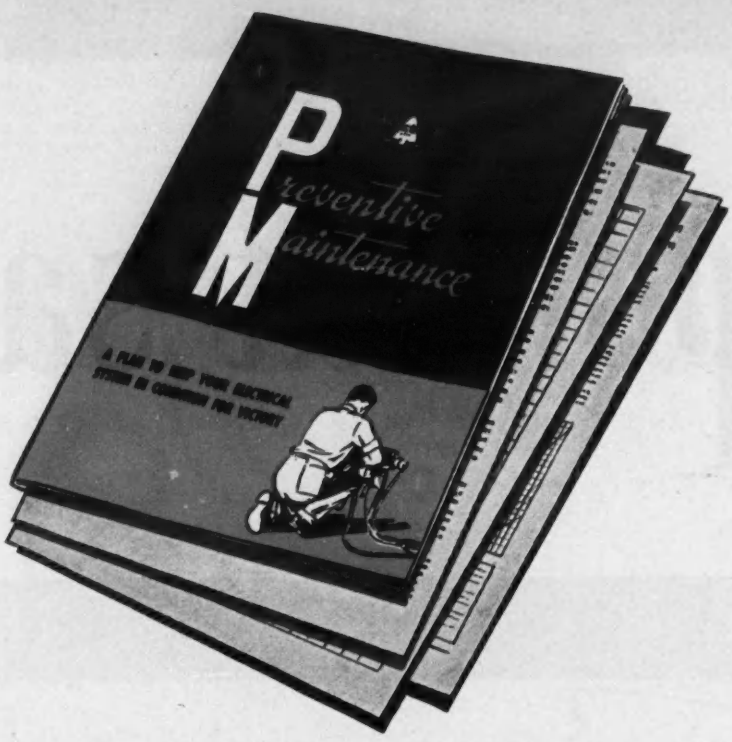
J-05141

Westinghouse PRESTITE

PLANTS IN 25 CITIES... OFFICES EVERYWHERE



The pressure-molded ceramic that can be .CORED.. WORKED...JOINED TO METAL... designed with METAL INSERTS



OVER 60 UTILITIES

are using the PM plan to spearhead service campaigns

Introduced a short time ago, Anaconda's Preventive Maintenance Plan is being widely used by utilities to help customers keep electrical systems operating *efficiently*—despite shortages in essential wiring equipment.

Already some 60 utilities are actively engaged in this program. With it, they are helping their industrial power customers maintain continuous wartime production by preventing electrical breakdowns.

1 WHAT THE PLAN IS

The PM plan is a simple but comprehensive way to safeguard war production by preventing electrical breakdowns *before they develop.*

2 HOW IT WORKS

The plan provides a practical means of making periodic, systematic analysis of circuits and equipment. Uncovers potential weaknesses . . . suggests ways to correct them . . . prevents overloading of lines.

Data thus gathered aids local W.P.B. Branches in reaching decisions on requests for materials to *prevent* breakdowns.

3 HOW UTILITIES BENEFIT

The PM plan helps utilities maintain close customer contact despite a lack of "something to sell." Offers basis for service campaign that definitely appeals to customers. Puts the utility in a leadership role for furthering war production throughout the area it serves.

If you aren't already utilizing the Anaconda Preventive Maintenance Plan, mail the coupon for full details.

"Tomorrow may be too late . . . do it today!"

ANACONDA'S PREVENTIVE MAINTENANCE PLAN

ANACONDA

Anaconda Wire & Cable Company
25 Broadway, New York City 4

Please send copy of the Anaconda Preventive Maintenance Plan for safeguarding wartime production.

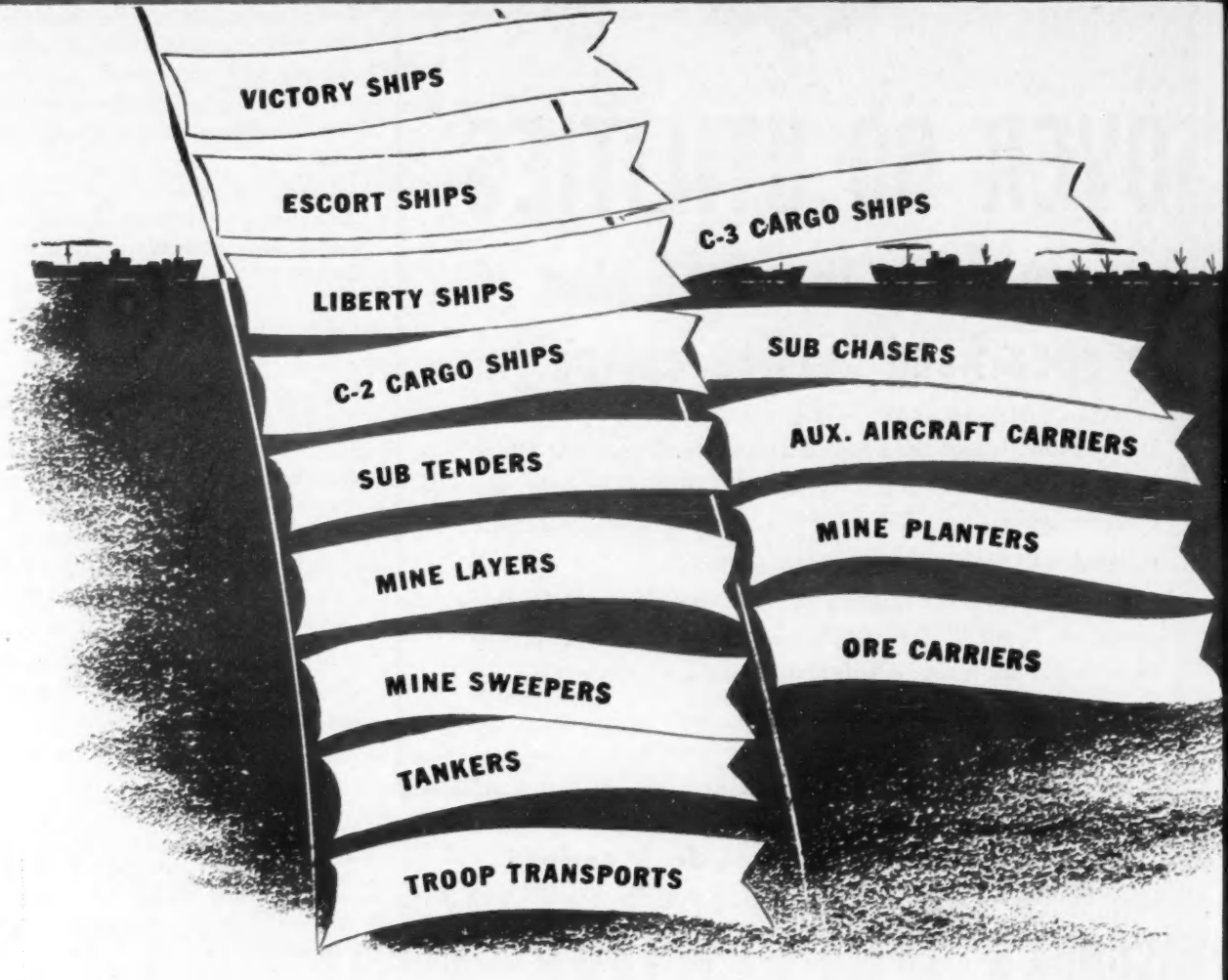
Individual .....

Company .....

Address ..... City .....

10T

Ships that sail

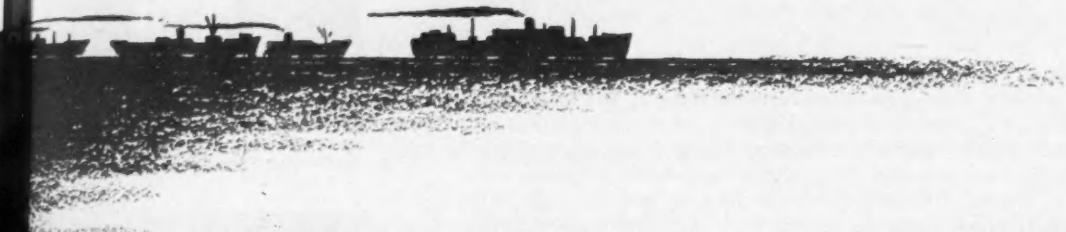


American Merchant Marine Needs Men!

To sail the ships that are being built by the skilled workers of America's shipyards, other experienced men are needed to serve in the American Merchant Marine. Men with sea experience as Mates, Engineers, A.B.'s, Cooks and Bakers should report immediately to the nearest U. S. Employment Service Office or write to the Recruitment & Manning Organization, Washington, D. C.

he seven seas...

Are powered by C-E boilers!



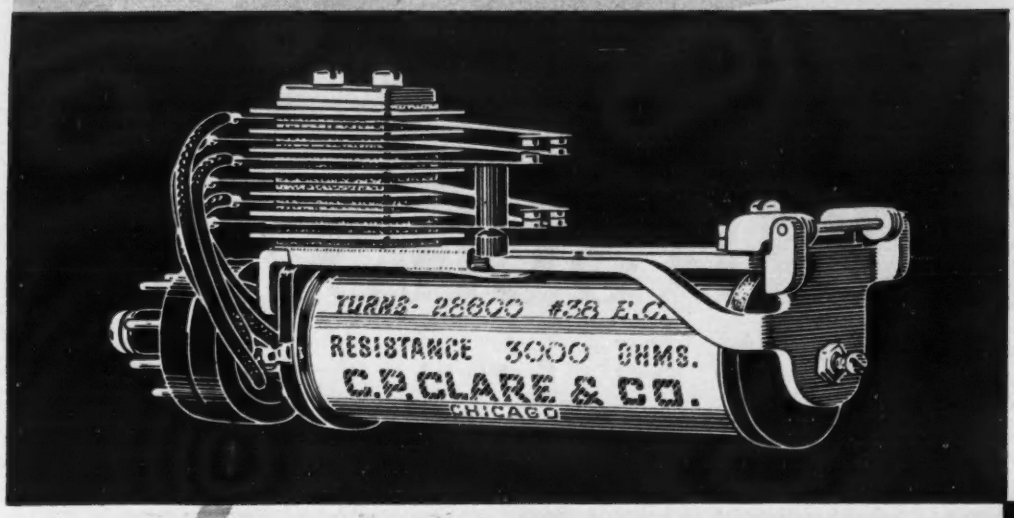
This list of merchant and naval vessels indicates the large part assigned to Combustion Engineering in the greatest shipbuilding program of all time. All of these classes of ships are included in contracts for boilers awarded to C-E during the past two and a half years – but even more impressive than their variety is their volume, the principal part of which is represented by the six types of cargo ships listed. When present contracts are completed, an aggregate of over 12,000,000 dead weight tons of cargo shipping will be powered by C-E Boilers. This is in excess of the dead weight tonnage of our country's entire pre-war merchant fleet.

This is a story of accomplishment in the marine field that is not without significance for the man who will dictate the choice of stationary steam generating equipment when the war is over. Here is involved a great wealth of experience compressed into a relatively brief period of time. Here new manufacturing facilities were required; new techniques were developed. All this will mean added values in the steam generating units which Combustion Engineering will build for stationary as well as marine needs of the future. A-743C

COMBUSTION ENGINEERING

200 MADISON AVENUE, NEW YORK, N. Y.

C-E



CLARE *"Custom-Built"* RELAYS

permit innumerable contact arrangements

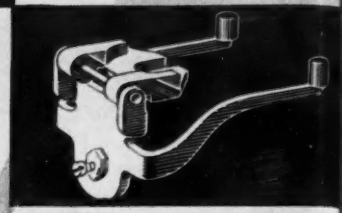
The Clare Type C d.c. Multiple Contact Relay fills the need for a relay where unusual control arrangements are required . . . for *automatic sub stations* to initiate and control equipment . . . *power stations,* especially steam plants, where boiler combustion control devices regulate proper relationship between fuel feed, water and steam pressure and steam out-put . . . for modern *pressure recording systems* for indicator and alarm circuits . . . for *sequence control* and *interlocking operations.* Wherever a relay is needed which will permit the innumerable contact arrangements to fill specified needs, this Clare "Custom-Built" Relay can fit the job. Behind this versatility and dependable operation are these unusual construction features:

Standard spring assemblies may embody any combination of five contact arrangements. As many as 20 springs per pile-up with two pile-ups per relay are available.

Coils are carefully wound to exact turns on precision machines. Lead-out wires are securely soldered. Coils are protected with a transparent acetate covering, and are available impregnated with special varnish.

Octal base plug mounting is illustrated. This makes for easy service and replacement. Other types of mounting, such as individual angle bracket, strip or panel, can be furnished.

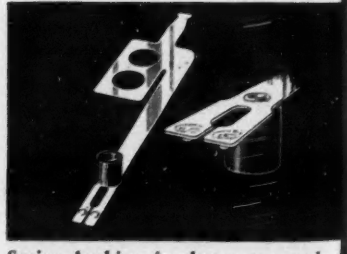
These features, plus the fact that all Clare Relays are carefully designed, well manufactured from best materials, and precisely adjusted, assure that this Clare Type C d.c. Relay will reduce overall relay cost, simplify installation and insure better and more dependable performance. Clare engineers are ready at all times to assist you in developing a relay specifically "custom-built" to meet your requirements. Send for the Clare catalog and data book. C. P. Clare & Co., 4719 West Sunnyside Ave., Chicago, (30), Illinois.



Double arm armature assembly of sta less steel shaft, operating in a marine br yoke. Heel piece, core and armatu assembly of magnetic metal.

High voltage spring pile-up insulators special heat treated Bakelite. Has mi mum cold flow properties, low moistu absorption content, and permits punchi without cracks or checks.

Contacts are welded to nickel silv springs by special process. May be precious metals or alloys in 12 differe standard, or special, types and sizes.

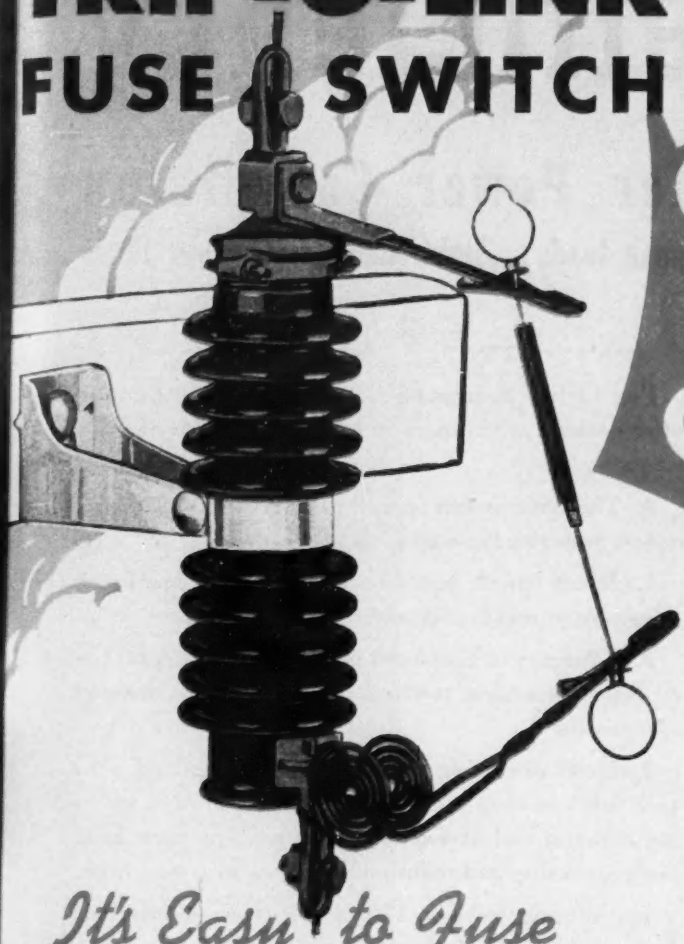


Spring bushing insulators are made Bakelite rod under patented process. R sist vibration and withstand heavy du service.

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical, Electronic and Industrial Use

KEARNEY TRIP-O-LINK FUSE SWITCH



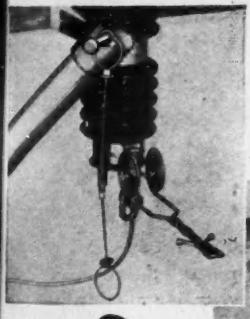
Gives You a NEW CARTRIDGE with each Re-fusing

YES — actually a new cartridge every time you replace a fuse, because the KEARNEY TRIP-O-LINK is a cartridge and fuse link combined. The dimensions of the bakelite covered fibre tube have been scientifically determined to extinguish power arcs at the first current zero.

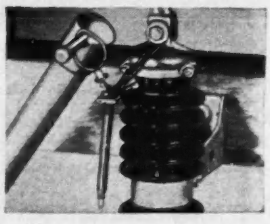
Measurable amounts of the fibre liners of all cartridges are burned away with each operation, the degree of burning depending upon the amperage and duration of the arc. Hence in ordinary designs fibre dissipation limits the cartridge life because the fibre liner is the sole arc-extinguishing agent in any fibre-lined cartridge. Gradual deterioration, charring and weathering through years of exposure also has its effect on the fibre of a permanent cartridge. This may explain why a fuse switch can operate successfully for years and then for no apparent reason fail to interrupt a low amperage fault.

Make sure that your protective devices are not subject to these limitations by using the KEARNEY TRIP-O-LINK fuse switch. A fresh, new, full-dimensioned fibre liner comes as an integral part of each link making your TRIP-O-LINK ready for whatever fault may come down the line.

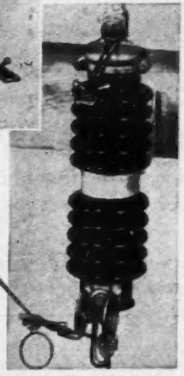
It's Easy to Fuse TRIP-O-LINK SWITCHES



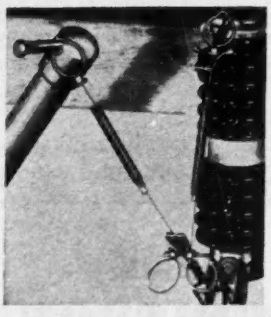
1 *Place top loop of link on puller arm of stick.*



3 *Raise top of fuse link into top V-groove contact and pull securely.*



2 *Place bottom of fuse link body (not loop) into lower V-groove contact.*



4 *Showing double V-groove contacts which permit fuse inspection without service interruption.*

WRITE FOR COMPLETE OPERATING DATA AND PRICES

JAMES R. KEARNEY CORPORATION

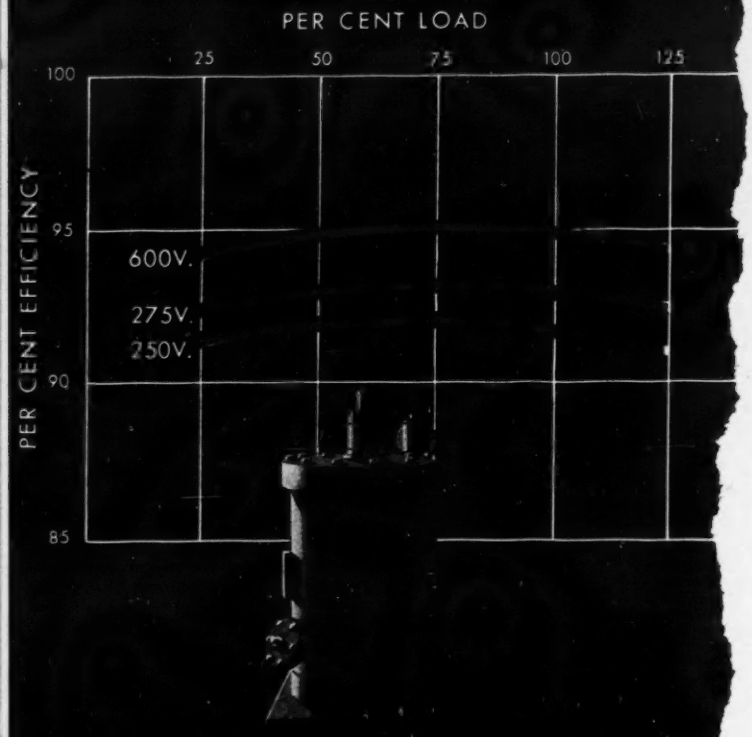
4236-42 CLAYTON AVE. (10) SAINT LOUIS, MISSOURI

uniformly high

efficiency

for Power Conversion

peak loads... light loads... 24-hour loads



This chart shows that the Ignitron Rectifier maintains its high efficiency over the entire load range . . . a fact which offers decided advantages in many applications.

For highly fluctuating loads, Ignitron Rectifiers offer decided advantages in power conversion. Here's why:

1. The Ignitron can operate at full capacity 24 hours a day, maintaining uniformly high efficiency.

2. It can handle high load swings easily, making it adaptable to widely diversified service conditions.

3. Efficiency at light loads is considerably higher than by other conversion methods, contributing to economy of operation.

Ignitron operating costs are low. Simplified control, low arc drop loss, the elimination of high starting demand and absence of major moving parts hold both operating and maintenance costs to a minimum.

Installation is easy, too. No special foundations are required. An Ignitron can be installed on any level floor of reasonable strength.

Investigate the advantages of the Ignitron for your particular d-c power requirements. Your nearest Westinghouse office can give you full information. Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

For war industries using d-c power

Ignitron power conversion can eliminate many production "headaches" for war plants. Completely self-protected, it can operate unattended. And because there are no major moving parts to wear and replace, inspection, repair and maintenance are cut to a minimum. Valuable production hours are saved. Ignitrons are always on the job—delivering service 24 hours a day.

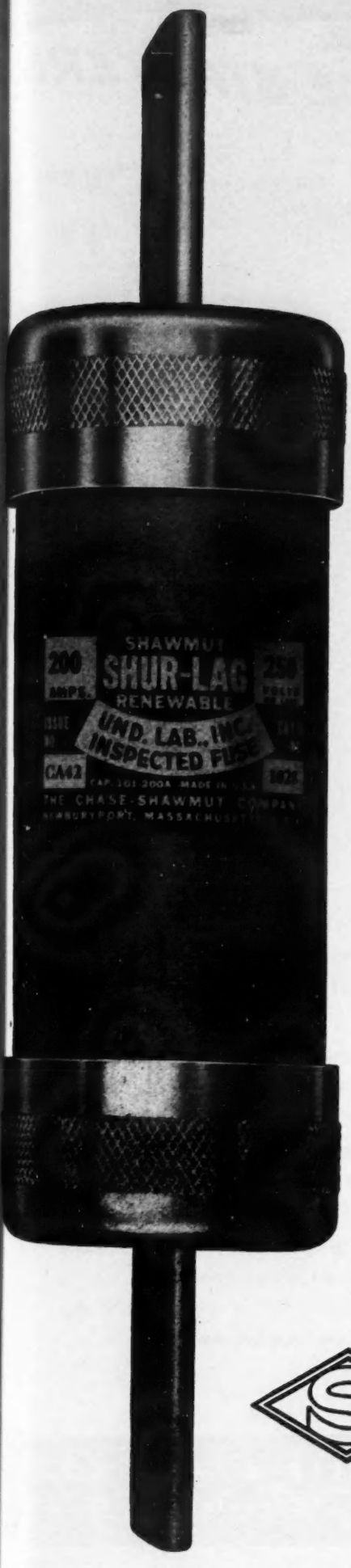
For more complete information about Ignitron power conversion, write Dept. 7-N today for a copy of Book B-3024.

J-10252-4

Westinghouse *Electronics at Work*

IGNITRON RECTIFIERS

PLANTS IN 25 CITIES
OFFICES EVERYWHERE



FIFTY YEARS

OF QUALITY IN THE

MANUFACTURE OF

ELECTRICAL EQUIPMENT

FOR CIRCUIT PROTECTION

★ 1893-1943 ★

SHAWMUT IS

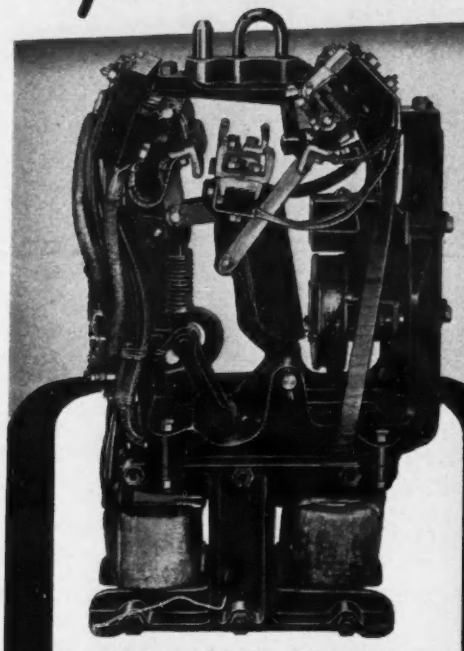
THE WORD

FOR FUSES

THE CHASE-SHAWMUT COMPANY

NEWBURYPORT, MASSACHUSETTS

EC&M REDUCED VOLTAGE STARTERS for 110-550 Volt MOTORS



COMPENSATOR MECHANISM

Single, quick-break, double-throw Contactor operated by a *single* magnet. Quick transfer from reduced voltage starting to full voltage running by a throw-over spring and a mechanical latch tripped by a current limit relay.

Bulletin 1045-A

Complete unit with conduit-connection box at rear and overload relays under cover-hood.

PUSH BUTTON OPERATED

HERE'S a starter that is very popular with operating and maintenance men. It is not an adaptation of contactor-equipment, but a simple, completely wired unit, totally enclosed and oil-immersed in a steel tank.

Total oil-immersion of the compensator-mechanism not only permits interrupting the circuit under oil (recognized as an effective means for breaking alternating currents) but also provides continuous lubrication for all operating parts of the mechanism and protects them from dust, moisture and corrosion.

In over 1000 plants, these EC&M starters have provided fool-proof, dependable operation for a number of years. Bulletin 1045-A completely describes them. Write for your copy today.

THE ELECTRIC CONTROLLER & MFG. CO.
2700 E. 79th St. ★ Cleveland 4, Ohio

Drop that extinguisher!

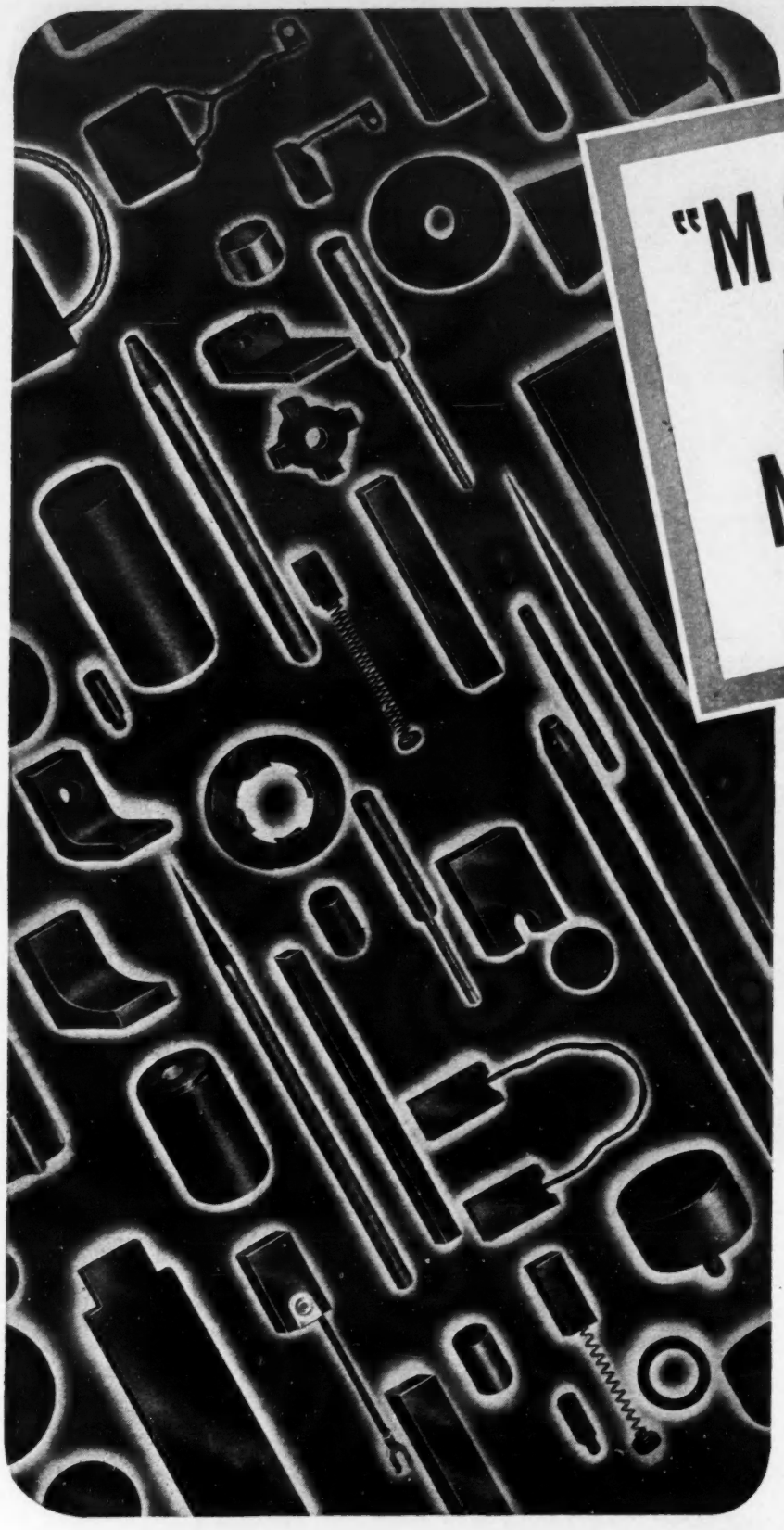
... unless you want to burn down the plant

The man who hits flaming oil with a soda-acid fire extinguisher is heading for trouble. He is using a good fire-fighter in the wrong spot. Soda-acid units are for "Class A" blazes, never for flammable liquids.

It's no good to have fire extinguishers, if your men don't know how to use them. *The wrong extinguisher may be more dangerous than no extinguisher at all!*

It is fortunate that the facts about fire extinguishers are easily understood, if correctly taught. Best way to teach them is by *demonstrating*. Show your own extinguishers in action against real fires. Do it at your plant.

"How To Teach Fire Fighting" has been prepared by Walter Kidde & Company to show you how your plant can handle fire-instruction. This illustrated book explains all classes of fires—tells you how to fight each successfully. You'll want a copy, free. Write Walter Kidde & Company, Inc., 1025 Main Street, Belleville, N. J.



"MOLDED" MEANS MODERN!

Throughout industry Stackpole solids molded from powders are paving the way to new, up-to-the-minute efficiencies. These products include not only the better-known Stackpole carbon, carbon-graphite, and composition products, including many precious metal compositions, but also new, far-reaching developments in solids formed from molded iron and iron-nickel powders. These latter utilize less critical materials, eliminate machining operations, and can be produced rapidly to exacting specifications. Our engineers will gladly cooperate in weighing the possibilities of such developments against your requirements.

TYPICAL STACKPOLE MOLDED PRODUCTS

Powder Iron and Iron-Nickel Components
Brushes and Contacts
(All carbon, graphite, metal and composition types)
Bearings • Anodes • Electrodes • Welding Rods, Electrodes and Plates • Pipe • Brazing Blocks • Brake Lining • Packing, Piston, and Seal Rings • Rheostat Plates, and Discs, etc.

STACKPOLE ELECTRONIC COMPONENTS

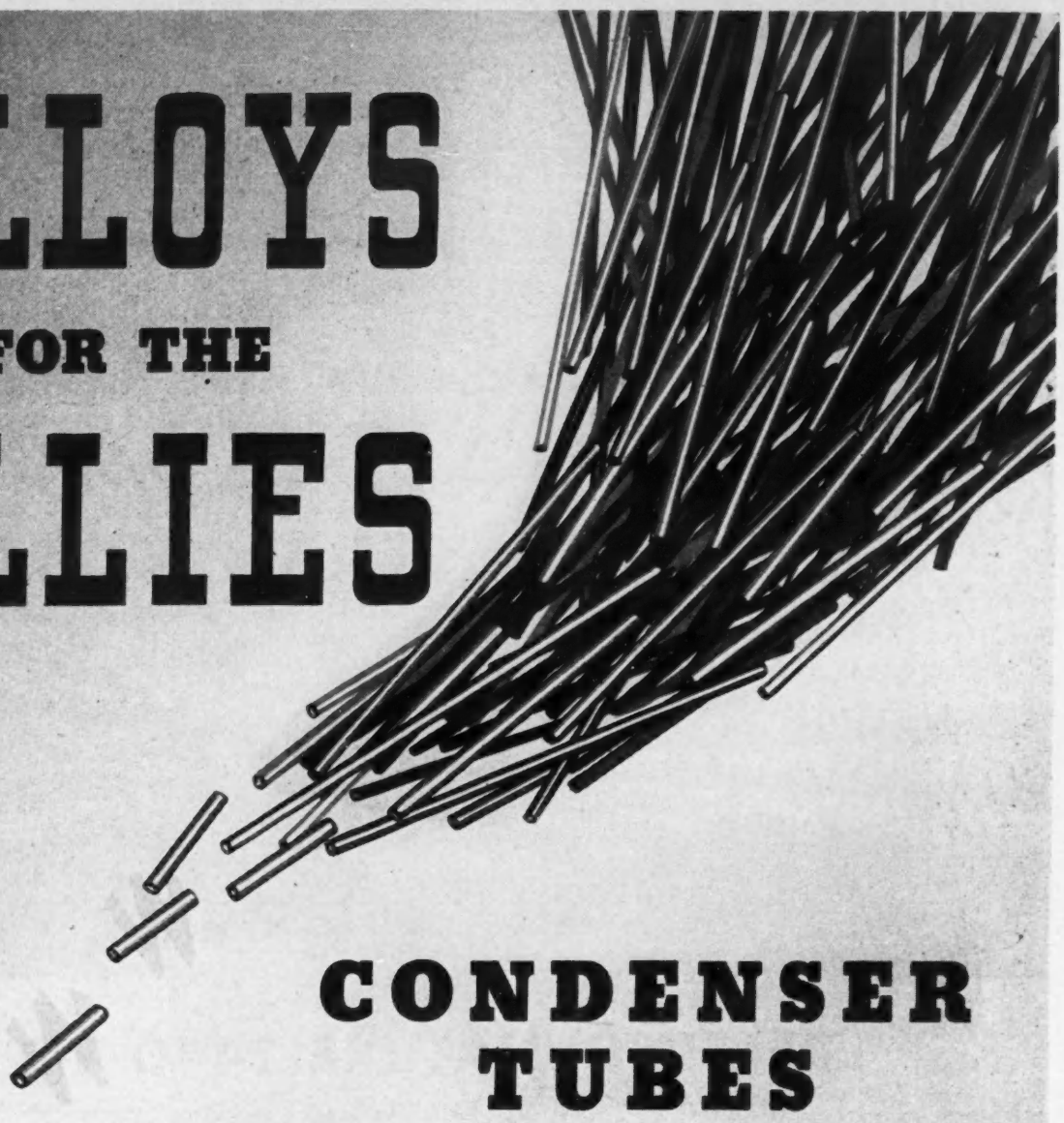
Fixed and Variable Resistors
Molded Iron Cores • Line Switches

STACKPOLE CARBON COMPANY, ST. MARYS, PA.

STACKPOLE

MOLDED METAL POWDER, GRAPHITE AND CARBON PRODUCTS

ALLOYS FOR THE ALLIES



CONDENSER TUBES

WOLVERINE PRODUCES CONDENSER TUBES IN THE FOLLOWING ALLOYS:

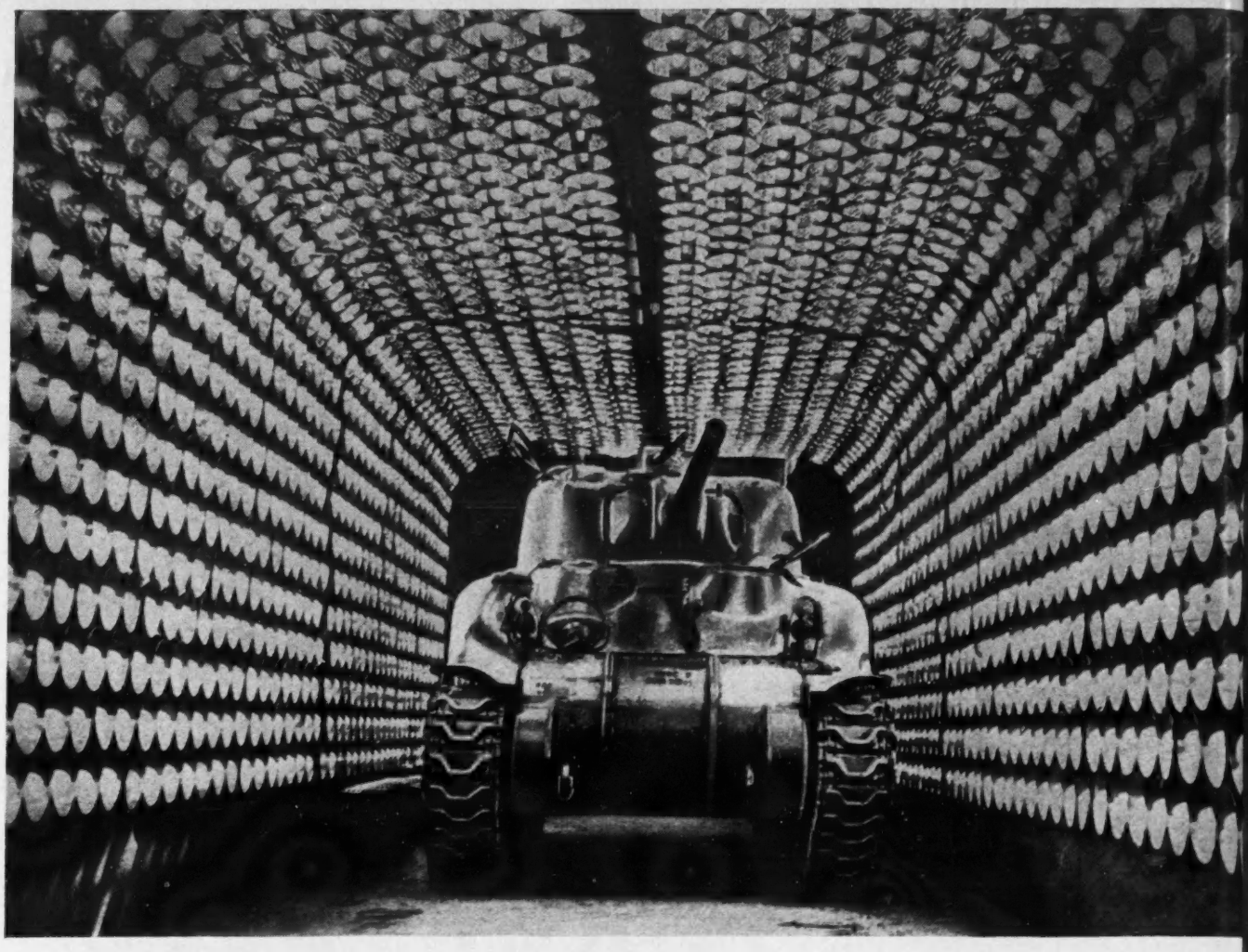
ARSENICAL BRASS "2 and 1" ALLOY
ALUMINUM BRASS "76/22/2"
PHOSPHORIZED ADMIRALTY
CUPRO-NICKEL "70-30"
ARSENICAL COPPER
"70 and 30" ALLOY
"85 and 15" ALLOY
"2 and 1" ALLOY
MUNTZ METAL
ADMIRALTY

CALUMET AND HECLA CONSOLIDATED COPPER COMPANY

WOLVERINE TUBE DIVISION

Seamless Copper — Brass

1427 CENTRAL AVENUE DETROIT 9, MICHIGAN



BEATING NATURE 1440 TO 4

INFRA-RED rays from this tunnel of lamps complete an ordinarily 24-hr. paint drying job in 4 minutes... so fast that drivers of freshly-painted tanks stay at the controls. This new method of quick-drying is a vitally important wartime use of electric light and power.

Furnishing America's ever-increasing needs for electric light and power requires peak output from turbo-generating equipment...and power plants everywhere are getting maximum efficiency from their steam turbines, by lubricating them with *Texaco Regal Oils.*

Texaco Regal Oils assure normal bearing temperatures, governors instantly responsive to every load change. They keep turbine lubrication systems clean, rapidly free themselves from air and water, highly resist emulsification, gum formation, sludging. *They are rust and oxidation inhibited.*

So effective have Texaco lubricants proved that they are definitely preferred in the various fields listed in the panel.

A Texaco Lubrication Engineer will gladly cooperate in the selection of the most suitable lubricants for your equipment. Just phone the nearest of more than 2300 Texaco distributing points in the 48 States or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

★More revenue airlines miles in the U. S. are flown with Texaco than with any other brand.

★More buses, more bus lines and more bus-miles are lubricated and fueled with Texaco than with any other brand.

★More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

TEXACO

REG T.M.

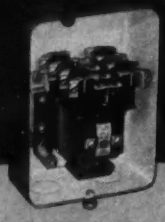
TEXACO Regal Oils

FOR ALL TURBINES

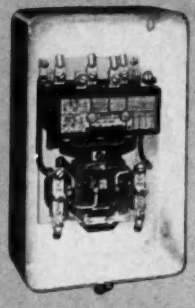
TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

Trouble-Free STARTERS for THREE-SHIFT OPERATION

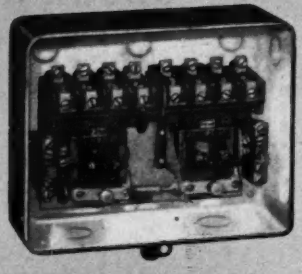
These solenoid motor controls . . . developed by Allen-Bradley . . . need no contact maintenance. They have only one moving part. There are no bearings . . . no pins . . . no pivots . . . no hinges to gum up and stick . . . no production delays from starter troubles when you standardize on Allen-Bradley solenoid motor control. Write today for "The Story of the Solenoid Starter." Allen-Bradley Company, 1316 S. Second St., Milwaukee 4, Wis.



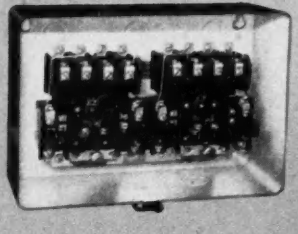
Solenoid Type Relays. These relays provide reliable and consistent sequence interlocking control for machine tool operations such as drilling, tapping, boring, milling, and grinding.



Across-the-line Starters. The simplest starters for a-c motors! They have only one moving part, the solenoid plunger with the double break, silver alloy contacts.



Reversing Switches. Used for across-the-line starting and reversing. They are mechanically interlocked so both contacts cannot be closed at the same time.



Multi-Speed Across-the-line Starters. Provide remote control for two, three, or four speed squirrel-cage motors used on machine tools, compressors, refrigerating, air conditioning, and many other applications.

ALLEN-BRADLEY

SOLENOID MOTOR CONTROL

QUALITY

ENCLOSURES

General Purpose

Here's the answer
to Your Limit Switch Problems

Bulletin 801-2
Complete Line
of Limit Switches

The Allen-Bradley 24-page Bulletin 801-2 is a handy electrician's handbook on limit switches and their applications. Every maintenance electrician will find this bulletin a valuable and convenient manual on automatic control. It is full of new ideas . . . new solutions . . . new devices. Send for your copy.

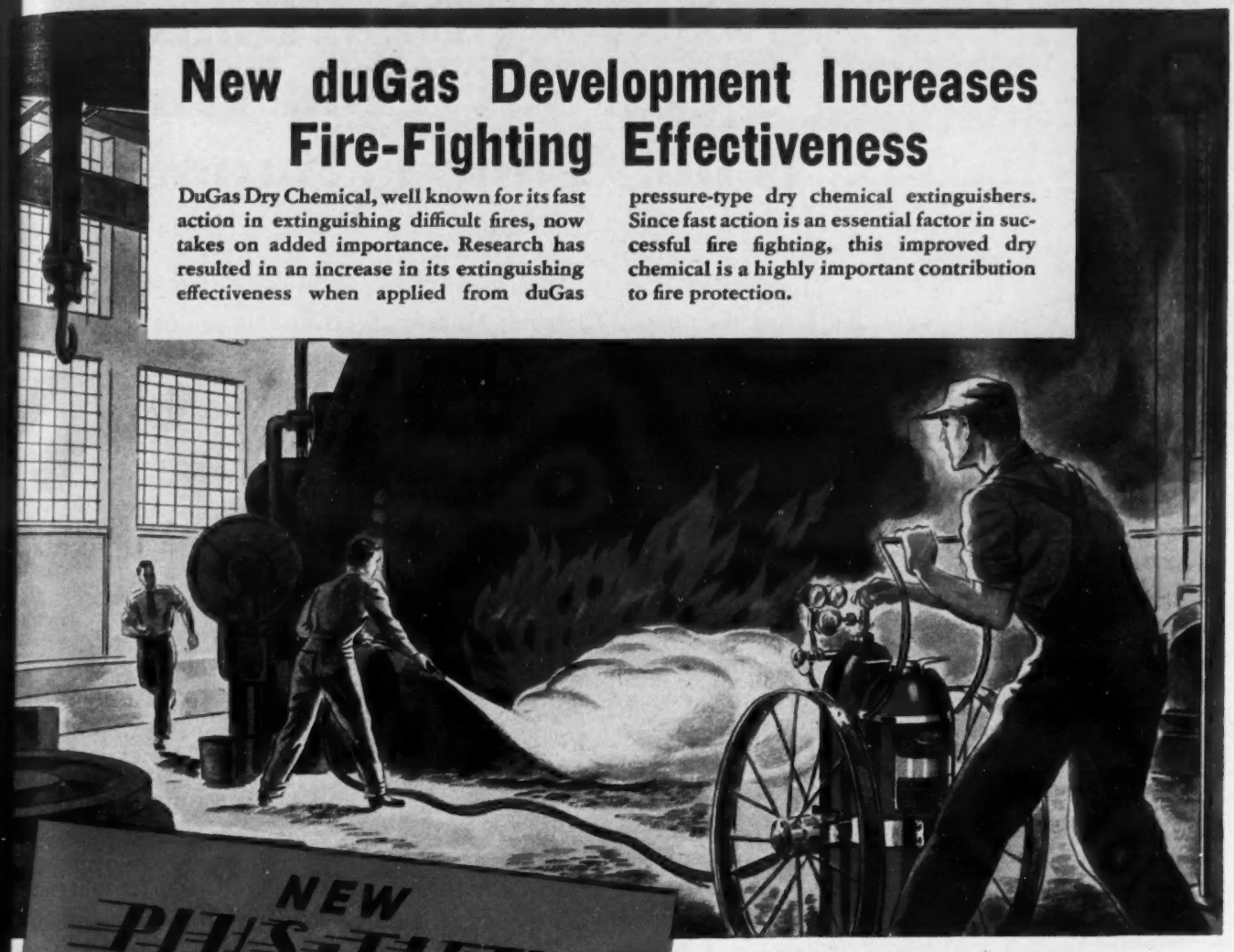
ALLEN-BRADLEY

BULLETIN 801-2 LIMIT SWITCHES

QUALITY

New duGas Development Increases Fire-Fighting Effectiveness

DuGas Dry Chemical, well known for its fast action in extinguishing difficult fires, now takes on added importance. Research has resulted in an increase in its extinguishing effectiveness when applied from duGas pressure-type dry chemical extinguishers. Since fast action is an essential factor in successful fire fighting, this improved dry chemical is a highly important contribution to fire protection.



NEW PLUS-FIFTY duGas DRY CHEMICAL

Proven by Hundreds of Practical Fire Tests

New PLUS-FIFTY duGas hangs in a cloud over the fire area, providing an increased smothering action and reducing flashbacks. Long range effectiveness of the dry chemical stream enables even an inexperienced operator to knock down fire from a greater distance. Like the former duGas, PLUS-FIFTY duGas Dry Chemical will not cake, harden, evaporate, deteriorate or freeze. It generates no toxic fumes and is not an electrical conductor.

NO PRIORITY NEEDED

Since no critical materials are used to produce the New PLUS-FIFTY duGas Dry Chemical, no priority is required...and there is no advance in price.

APPROVED by the Underwriters' Laboratories and the Factory Mutual Laboratories.

... WRITE FOR COMPLETE BULLETIN ON NEW PLUS-FIFTY DUGAS and Priority Information on Extinguishing Equipment.

Available in Models 15 and 30 Hand Extinguishers, Models 150 and 350 Wheeled Extinguishers.

Model 30
Hand Extinguisher

WRITE FOR chart showing characteristics of *all* types of approved hand fire extinguishers.

DUGAS ENGINEERING CORPORATION

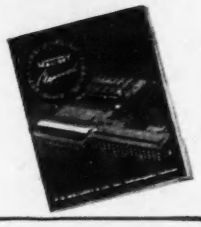
OWNED AND OPERATED BY
ANSUL CHEMICAL COMPANY, MARINETTE, WISCONSIN

Mallory Distributors Can Save You Time When Time is Important

Quick, complete information and prices for your purchasing department.

Application data for your engineering and design departments.

Service from stock.



A copy of the Mallory catalog for ready reference.

Lack of a few parts can wreck almost any production schedule. But when the needed parts are Mallory electronic products, the Mallory distributor is the man to turn to for help.

For example—one manufacturer discovered, just the day before scheduled use, that a number of selector switches required for the launching apparatus of a new aircraft carrier were missing. Something had gone wrong somewhere. But a wire to a Mallory distributor found him with the exact circuit arrangement in stock. The switches went out via air express and the carrier was launched on time.

Example Number Two—Navy Code Schools in two universities urgently needed a number of electronic products, among them Mallory switches and jacks, in order to inaugurate training of code operators on schedule. Something inexplicable had gone wrong and the parts were missing. Again, a Mallory distributor stepped into the breach to save the day in jig time.

Nothing very dramatic about this, it is true. But it demonstrates how Mallory distributors are geared to save time in furnishing essential electronic parts for essential uses . . . especially where small orders are concerned.

Where essential electronic parts are required—for maintenance, laboratory and testing devices, pre-production models—in short, where small quantities are involved, the Mallory distributor stands by to help. We are doing our level best to keep his stocks adequate. Proper ratings are needed? Certainly!

But make his acquaintance. He can be of service in many ways. If you do not know the name of the Mallory distributor nearest you, we will be glad to tell you.

P. R. MALLORY & CO., Inc. INDIANAPOLIS, INDIANA • Cable Address—PELMALLO

P. R. MALLORY & CO. Inc.
MALLORY
APPROVED
PRECISION PRODUCTS

AIR IS LIFE TO A SANDHOG . . .

but DEATH to unstable turbine oils!

HOW MUCH AIR can your turbine oil stand before it "folds up"? There are turbines from which samples of Shell Turbo Oil have been taken after 20,000 . . . 25,000 . . . 30,000 and more hours of operation. Certified chemical analyses of these samples show no appreciable sign of deterioration of Shell Turbo Oil. And what's more, oil and systems were free from even the slightest trace of *rust!*

Are you getting this kind of performance from the turbine oil you now use? Don't guess about it. Compare its performance with the records of performance of Shell Turbo Oil taken from our files, which the Shell man will be glad to show you on request.

Call in the Shell man now! Or, write Shell Oil Company, Inc., Dept. "G," 50 W. 50th Street, New York 20, N. Y. or 100 Bush Street, San Francisco 6, Cal.

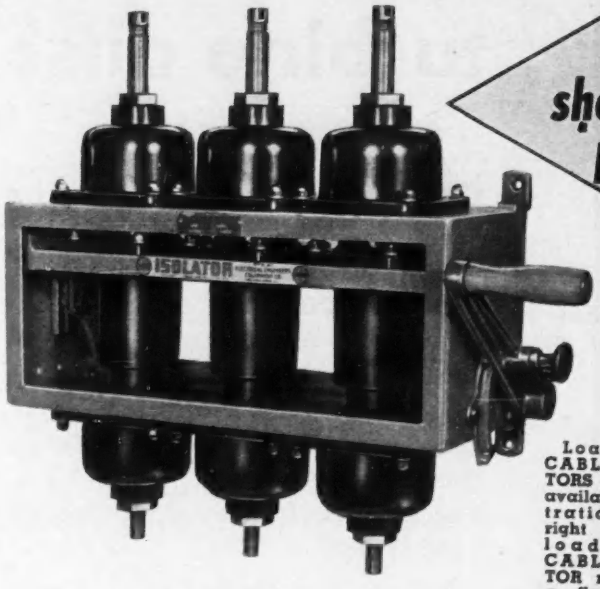
SHELL

SHELL TURBO OIL

Currently the U. S. Navy has first call on Shell's entire production of marine turbine oil

And NOW a LOAD BREAK ISOLATOR.. IS AVAILABLE

Detachable load break devices shown on a 5 Kilovolt Type MC Load Break Isolator.....



Load break CABLE ISOLATORS are also available. Illustration to the right shows the load break CABLE ISOLATOR mounted in a flanged steel cabinet arranged for bolting directly to the tank of a three phase transformer.

★ The ISOLATOR has been the greatest advance in the art of disconnecting high voltage circuits brought forth in recent years. The ISOLATOR as originally developed and up until now has been purely a disconnecting device.

After months of research, development and testing, the Electrical Engineers Equipment Co. are pleased to announce a load break ISOLATOR for safe operation under light loads and charging currents of transformers, regulators, cables, etc. The new load break ISOLATOR very closely approximates the disconnect ISOLATOR in size and appearance. The load break feature is detachable, and can be removed and replaced without opening the circuit.

Bulletin #138 which is now ready for distribution will give detailed information on the load break ISOLATOR. Write for your copy.

THREE E

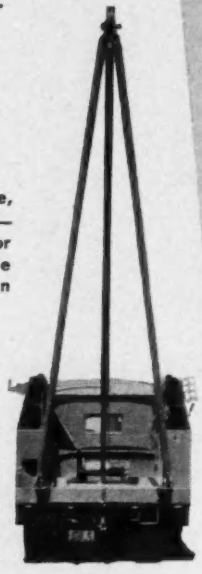
ELECTRICAL ENGINEERS EQUIPMENT CO.
MELROSE PARK ILLINOIS

FWD LINE CONSTRUCTION AND MAINTENANCE EQUIPMENT THAT CONSERVES CRITICAL TIME AND MAN-POWER

Model 1775 Pole Trailer Especially adapted for high-speed hauling of poles over short and long distances. Because of its wide tread, this unit trails at high speeds without snaking or whipping. Light in weight, two men can easily lift it onto a truck when moving from one operation to another.

Sure Binder (Handiest tool you ever used) The Sure Binder is a portable hand winch for binding bulky loads of all types. Ratchet type drum holds 18 ft. of 5/16 inch cable. Weight complete: 18½ pounds.

Utility Pintle Hooks Provide a sure, safe connection between truck and trailer — on any make of truck. Available in sizes for towing loads of 1 ton or less and up to the universal type for towing anything that can be moved.

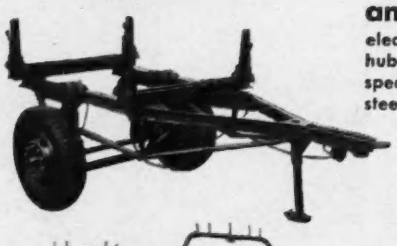


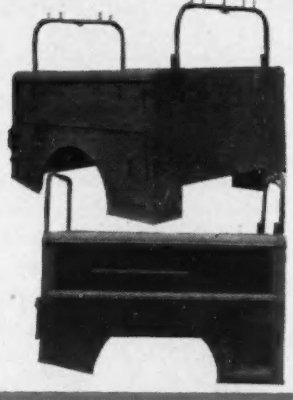
M Type Pole Derrick Made of the best seamless steel tubing properly heat treated. Available in sizes to handle poles from 25 ft. to 70 ft. in length.

OTHER UTILITY TOOLS

- Earth Boring Machines
- Power Take-Offs
- Duct Rodding Machines
- Low Bed Trailers
- Trailer Hitches
- Cable Laying Plows
- Steel Utility Bodies For Pick-Up Trucks
- Guy Wire Forming and Cutting Tools

SEND FOR LITERATURE





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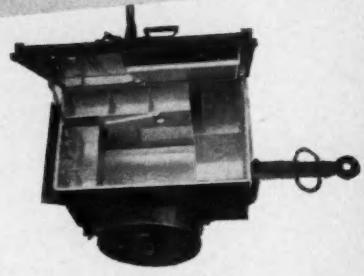

Combination Cable Reel and Pole Trailer This unit has electric steel spoke wheels of integral hub type. Timken roller bearings, and special heat treated chrome vanadium steel springs. All castings are electric steel cast. Axle material is 40-50 carbon steel, specially heat treated. The main frame and cross member 4", 9½ lb. I-beam. All trailers furnished with one set of pole hauling bolsters, and one set of cable reel saddles.

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P8T Series. Available in heavy load capacities of 3100 to 8200 lbs. Extension tongue permits hauling of poles up to 40 ft. Optional electric brakes, side boards, stanchions, etc.

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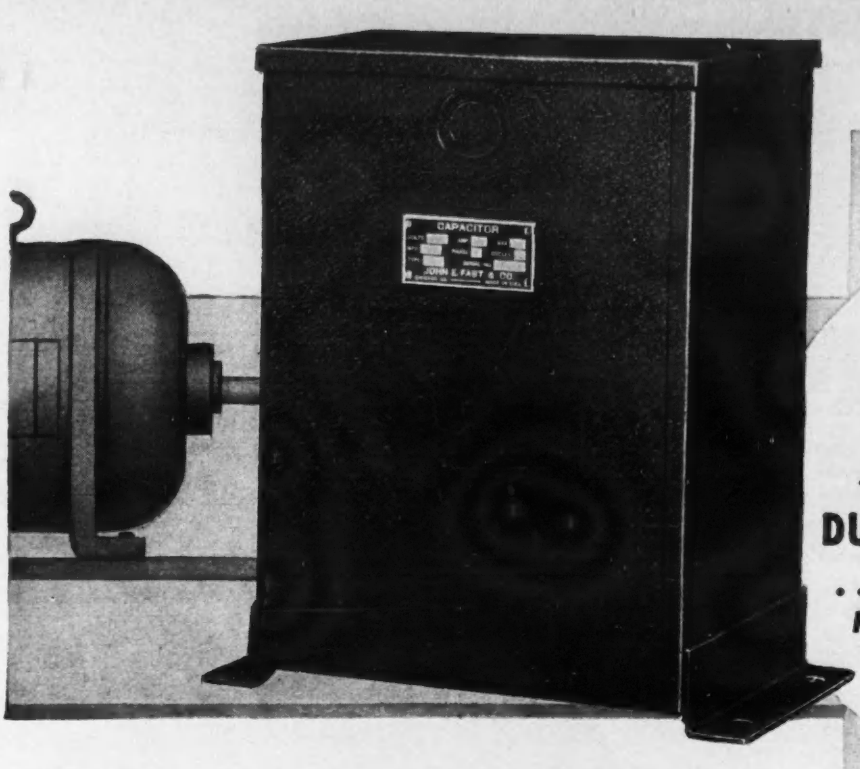

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. . . for more efficient Power Factor Correction at or near INDIVIDUAL machines or motors.

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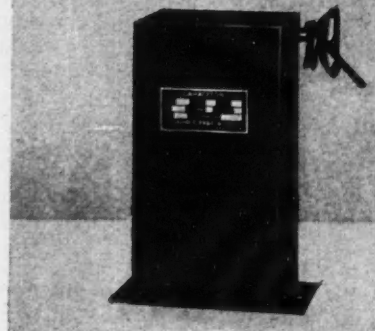

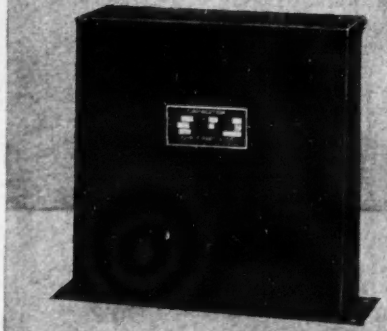

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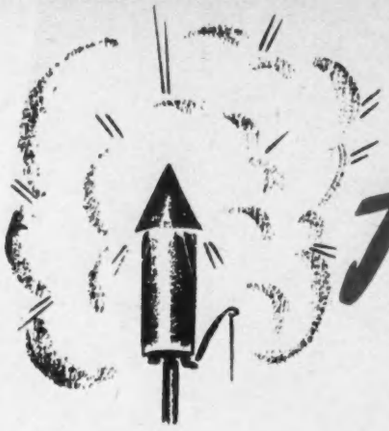

All Clear

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MAXIMUM PROTECTION REGARDLESS OF INSTALLATION CHARACTERISTICS

The performance of the Thermaload V Solenoid Starter is unaffected by extremes in ambient temperature because of an exclusive feature . . . the Monitor Compensated Overload Relay. The trip always occurs within the same time at a given percentage of overload.

TAMPER-PROOF PROTECTION

Thoughtless workmen can't prevent the trip by "Blocking in" the reset button. Button must be pressed in and then released before contact is made.

LONGER LIFE FOR YOUR MOTORS

The proved performance of the Monitor Compensated Overload Relay combined with Monitor Tamper-Proof Reset Button eliminates the inevitable harm resulting from excessive overload. Irreplaceable motors give longer, better service . . . maintenance costs are lowered.

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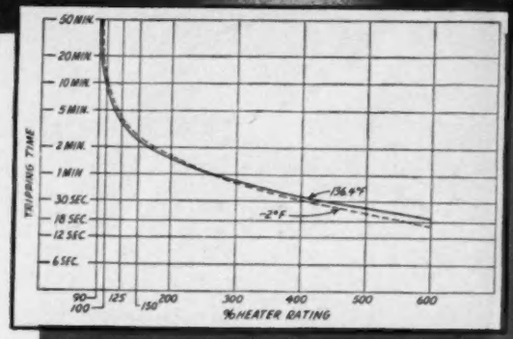
Motors that are guarded against harm are not apt to break down under "Production for Victory."

AVAILABILITY

Can be shipped from stock under existing priority regulations. Available for 1.5 to 7.5 H. P.—110 to 550 Volts (A.C.); also in combination units.



This graph shows the performance of the Monitor Compensated Overload Relay at —2°F and at + 136.4°F. Note that at 600% motor rating tripping time varies only a few seconds. That's REAL overload protection.

★

SEE YOUR MONITOR FIELD ENGINEER OR WRITE FOR SHIPPING INFORMATION, TECHNICAL AND INSTALLATION DATA.

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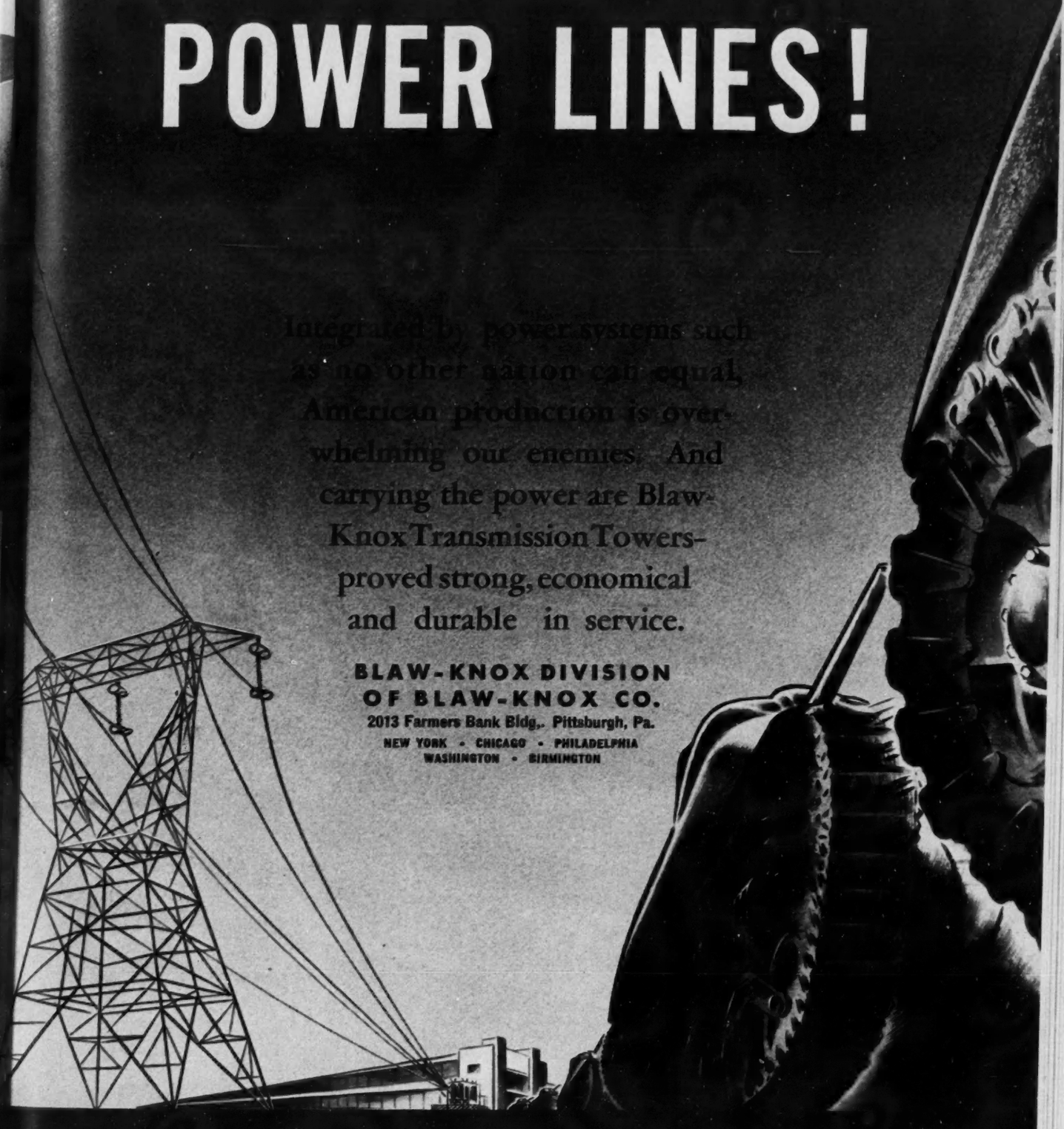

Integrated by power systems such as no other nation can equal, American production is overwhelming our enemies. And carrying the power are Blaw-Knox Transmission Towers—proved strong, economical and durable in service.

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"To keep away from Rust...

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NATIONAL
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Opportunity

What are we going to tell our young men when they come home from war looking for opportunities? Are we going to tell them that the electrical industry has more troubles than a dog has fleas? Are we going to tell them what we have been muttering to each other for the past decade, or are we going to tell them something different?

The Army is now asking for information to transmit to our fighting men—fellows who want to know if they are fighting for a better world, a world of opportunity or for a world of government-controlled security. Shall we tell them that electrical contractors see little chance of getting ahead because of competition, that wholesalers can't make money because of insufficient margin and competition, that vicious price cutting is holding the manufacturing business back and that, what with mounting taxes, disintegration of holding companies and government ownership expansion, the utility business is on the skids?

Add to these grousings of long duration the current complaints of business about regimentation, investigations, labor regulations, mounting government debt and government in business, and what have we that is encouraging to youth? Youth has always been willing to take chances, it has always brushed aside the difficulties, provided only that there was opportunity. Take away the vision of opportunity and what is left other than security?

Young industries, such as aviation, light metals, plastics and electronics, have about them a certain aura of romance, which is always attractive to youth. Are the older industries, such as the electrical, going to let the cream of the crop pass them up for these glamor industries?

Post-war planning by its very nature starts with the premise of a future—something to plan for. What is that future? Can we not dwell on that for a while instead of on our economic and political aches?

Just as we could not have won this war without an adequate supply of power, so will it be necessary to have more and more power to win the peace. If we are to have an improving standard of living, and pay our debts, we must have more goods for less money, and the only way we can do that is to put more power behind the worker.

The advent of fluorescent lighting made the lighting of America obsolete. There is a complete relighting job to be done. The homes of America have rediscovered the need for electrical conveniences, now that appliances are no longer available.

Our farms will never again depend to such a large extent upon manual labor, but will absorb vast quantities of electrical equipment—a new market representing a large part of our population.

As a matter of fact, the first ten years after the war should be bigger than any previous peacetime decade. Because of its demonstrated public need electricity offers more opportunity to serve mankind than any of the other glamor industries. But to sell it to our young men we must believe. We must turn-about face and stop selling ourselves short.

Low-Pressure, Gas-Filled Cables Go on 34.5-Kv. Duty

Indiana utility installs low-pressure, nitrogen-filled cables for use on 34.5-kv. transmission network — Believed first submarine installation of such cable — Describes design, installation experiences, performance

S. W. WINJE* and M. F. SCHONEFELD,† Indiana Service Corporation, Fort Wayne

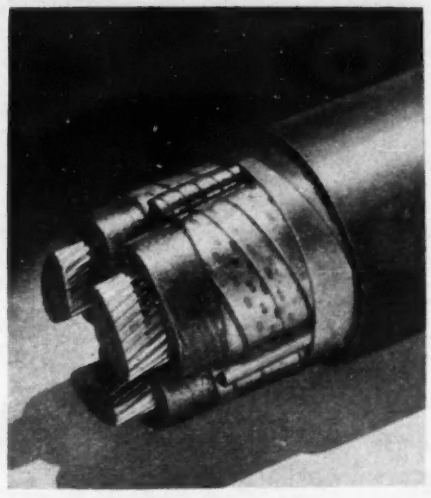
INSTALLATION of low-pressure nitrogen-gas-filled cable operating at a voltage in excess of 27,000 was completed this year on the 34.5-kv. transmission network of the Indiana Service Corporation at Fort Wayne. The two circuits, each 3.9 miles in length, also include sections which constitute the first use of a low-pressure nitrogen design as submarine cable.

The installation developed when impending loads on the transmission network in Fort Wayne prompted investigation of feasible methods of increasing capacity and reliability of power supply in the area. Network analyses recommended the interconnection of two points on the system with two circuits over the most direct route. This route was through the congested underground area in downtown Fort Wayne and called for two river crossings.

Preliminary Factors

Use of solid cable of either the single-conductor or three-conductor type was considered, also solid cable with oil-filled joints. However, single-conductor cable was almost prohibitive due to congestion and the scarcity of ducts. Various problems conflicted with oil-filled arrangements, principally the lack of manhole space and high cost. Cable sheath damage in this system area has been rather frequent due to severe electrolysis. Mechanical damage also was frequent due to construction activity.

When compared with cable of solid design, it was anticipated that better performance would result from the more favorable thermal and dielectric characteristics of a gas-filled cable. Furthermore, about 85 percent of all cable failures result from sheath damage such that actual circuit failure follows after an appreciable time.



SAMPLE cut-away section of 34.5-kv., low-pressure, gas-filled cable

It was believed that a system of gas pressure supervision used in such an installation would enable detection of sheath damage in the majority of cases before the circuit failed.

Cable Design

These considerations led to the adoption of General Electric type GF, low-pressure, nitrogen-gas-filled cable consisting of three 300,000-cir.mil, compact-sector conductors. Each conductor is insulated with 310 mils of paper and shielded with perforated copper tape. Interstices between conductors contain three gas tubes, two of open spiral steel tape construction and the third of solid wall lead tubing. This assembly is bound with 1-in.x4-mil bronze binding tape. Jute filler ordinarily used in the interstices of solid cable, was entirely omitted from this design. The sheath consists of 133 mils of copper-bearing lead. This cable is rated by the manufacturer for 35,000-volt, solidly grounded neutral operation.

River crossing runs employed the same type of cable with a protective armor added, consisting of two layers of jute cord impregnated with a tar compound, between which was placed a layer of No. 4 BWG steel-wire armor rods. A specially designed armor-rod anchorage was installed in the manholes on both sides of river crossings. Outside diameter of the unarmored cable is 2.74 in. and the outside diameter of the armored submarine cable is 3.59 in.

Shipped Under Pressure

Each shipping reel contained only one length of cable equipped with a hollow-core, pulling-bolt assembly on one end and a $\frac{3}{4}$-in. O.D. lead pipe about 12 in. long with Schrader valve stem wiped to the other end. This permitted testing the gas pressure of each cable length on the reel or after pulling in. Gas pressure was read immediately upon receipt of shipments and periodically thereafter until installation was completed.

Identical methods were used for handling and pulling in the cable as for solid type cable. However, gas pressure readings were taken and recorded after each length was pulled in, to make sure that no leaks had developed from injury to sheath or end assemblies. Wherever gas pressure

*Manager Electrical Operations.
†Manager Engineering and Service.

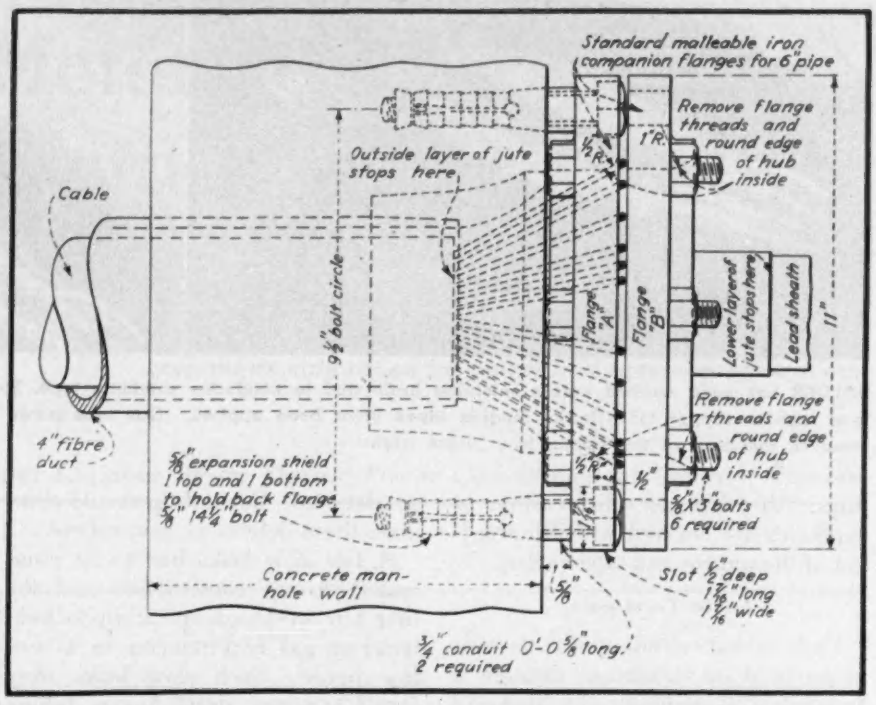
was found to be below 4 psi. it was raised to 8 psi. by supplying super-dry nitrogen from portable cylinders.

Installation and Splicing

Forming and racking the cable in the manhole was done in the conventional manner. To make certain that no air entered the cable a positive gas pressure of 1 to 2 lb. per sq.in. was maintained on each section being spliced. This was done by "floating" portable gas supply cylinders on the cable in manholes adjacent to the splicing operation. Various parts of open ends of the cable were covered with sponge rubber pads during splicing and the gas tubes plugged to reduce bleeding of gas. About one-half of a 200-cu.ft. cylinder of gas was bled per joint.

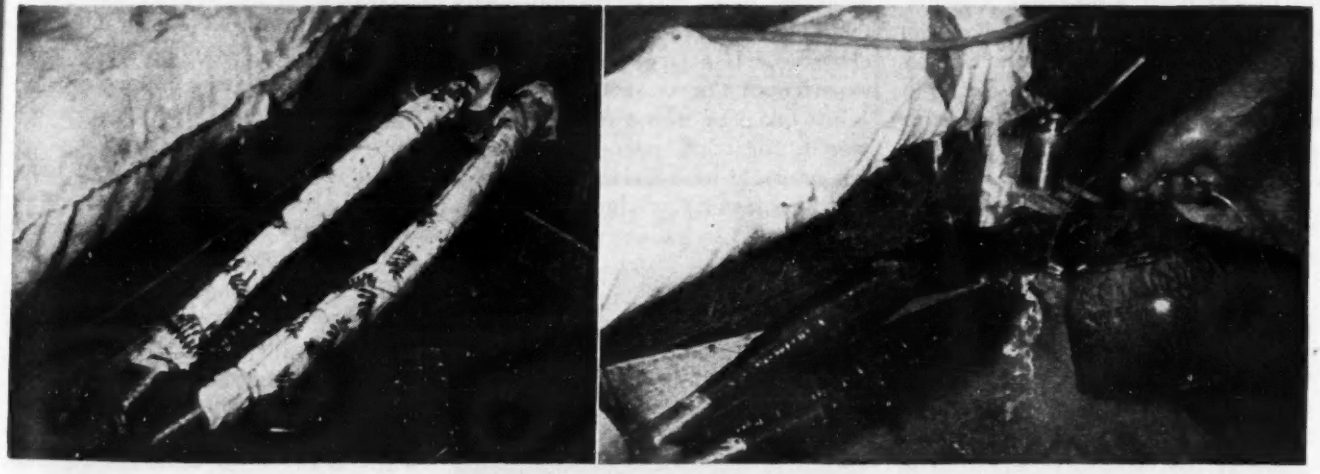
Penciling insulation, insulating tapes and shielding tapes were applied as in the usual high-voltage joint. In many cases, due to the short manholes, it was necessary to halve the joint casing and make a center wipe. "Victory" wiping solder was used successfully. In each joint the lead gas tube from one section is spliced to a $\frac{3}{8}$-in. copper tube, which is brought through the end wipe and connected to a fitting outside of and on the upper side of the casing. This fitting is arranged to feed gas into the casing and permit temporary connection of devices for measuring pressure or direction of gas flow, or both.

The lead tube from the other section is terminated inside the casing near the inlet of the fitting. All spiral tubes are cut off at their point of entrance to the casing. Rubberized duck tape and asphalt compound was applied to the outside of the casing to prevent the possibility of "growth" of the casing when full gas pressure is maintained. Upon completion the joint casing was purged of air by opening the fittings, raising the gas pressure on the cable to 15 psi. and allowing the air and finally some nitrogen to escape. A check for gas leaks was then made by using a soap solution applied over wipes and fit-

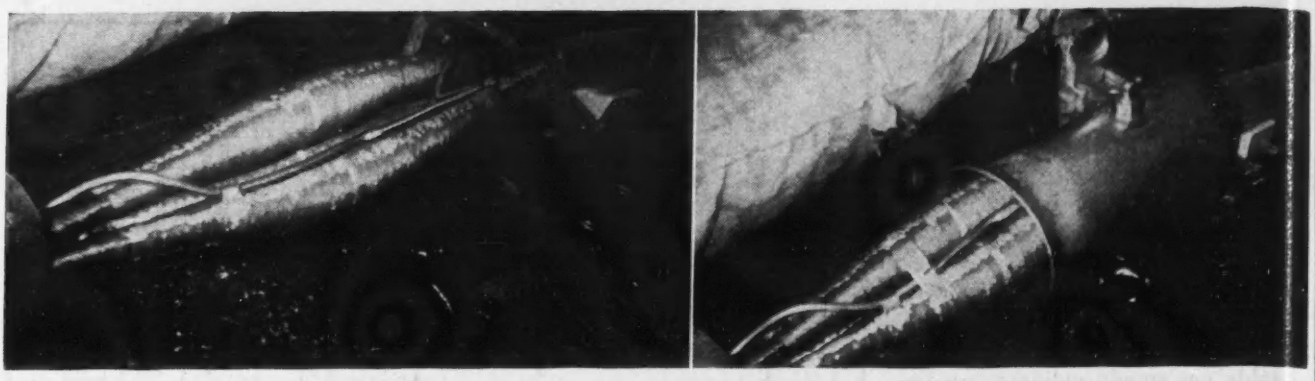

Standard malleable iron companion flanges for 6" pipe
Remove flange threads and round edge of hub inside
1"R.
½"R.
Outside layer of jute stops here
Cable
9½" bolt circle
Flange "A"
Flange "B"
Lower layers of jute stops here
Lead sheath
11"
Remove flange threads and round edge of hub inside
4" fibre duct
⅝" expansion shield 1 top and 1 bottom to hold back flange
⅝" 14¼" bolt
½"
⅝"X3" bolts 6 required
Concrete manhole wall
1"
⅝"
Slot ½" deep 1⅞" long 1 1/16" wide
¾" conduit 0'-0 ⅝" long. 2 required

ARMOR rods in submarine cable sections were anchored as shown between standard malleable iron pipe flanges bolted to the manhole wall. Procedure was:

1. Set two ⅝-in. expansion shields on vertical center line of duct ends bells on 9½-in. bolt circle.
2. Remove outside layer of jute from end of cable to a point 2 in. back of duct face.
3. Slip flange "A" over the cable, insert all bolts and bolt to the wall. Paint backside of the flange before installing.
4. Cut off No. 4 BWG armor wire from the end of the cable to a point approximately 12 in. inside manhole wall.
5. Fan out and form armor wire around the flange.
6. Install flange "B" and bolt securely.
7. Cut off armor wire approximately ¼ in. beyond flanges.
8. Paint with a heavy coat of asphalt paint.
9. Remove lower layer of jute from end of cable to a point 2 in. from flange "B."



TWO CONDUCTORS protected with oil silk cloth while insulation on third is built up with ½ in.,, ¾-in. and 1-in. tape (left). Hot flushing oil is applied frequently during taping to remove possible surface moisture. Insulating compound is brushed on between tape layers (right)



SOLDER has been applied across shielding braid and to conductor shielding tape. Main gas tubes are in place. Note splice of lead tube to copper tube (left). Binding tapes have been applied. Gas tube plugs and taping to prevent gas loss have been removed and half of the casing is in place (right)

tings. All cable and splice casings in manholes are covered with fireproofing of the cement-and-tape variety.

Cable Terminals

Each cable is terminated at its ends in an outdoor substation through a "spreader" assembly, lead tubing and single-conductor 46-kv. pothead. The potheads are equipped with a semi-stop seal in the base and are filled with a petrolatum compound. A $\frac{3}{8}$-in. copper supply line connected the permanent gas cylinders and gas control equipment to each spreader. Gas supply, pressure control and alarm facilities are provided at both ends of each cable. No point in the cable, then, is further than 2 miles from a gas supply, and in the event of a leak gas can be fed to it from both directions.

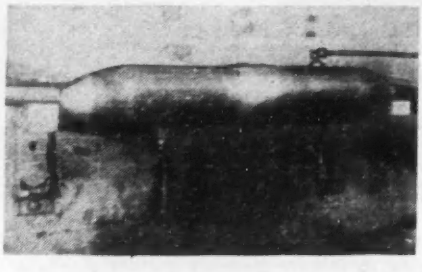
A gas-pressure relay, connected in each supply line, is adjusted to close its electrical contacts at pressures below 10.4 psi. or above 15 psi. at 25 deg. C. These relays are ambient temperature biased; for example, a relay set to signal on a high gas pressure of 14 psi. at 5 deg. C. will signal at 15.5 psi. when the temperature is 35 deg. C. An alarm is given at a remote switchboard when cable gas pressure gets above or below desired range.

Experience

Experiences during installation of this cable have led to the adoption of dry nitrogen gas for testing splice casings of 13.8-kv. solid cable on our system before such joints are filled with compound. All of our splice casings in the new gas-filled cables must be gas-tight, and it is felt that many of the failures experienced in the past with 13-kv. solid cable joints are due to porous wipes, defective filler plugs, and the like, which were not detected. Gas testing should eliminate these defects in new splices.

A few slow leaks had to be eliminated during construction and the first few weeks of operation to hold make-up gas requirements to a very low figure. Such slow leaks were found in wipes, sleeve bosses, tubing fittings, terminal gaskets, gas control accessories and the like. The make-up gas requirement now seems to be low. We feel that practically all leaks developing after all installation work is completed will represent actual failures in terminal gaskets, lead sheath, casings or wipes, and that we will usually be able to detect them before the 34.5-kv. system is subjected to a cable fault.

If the location of a leak is not known, it is determined by pressure differential tests made at various joint casing connections along the cable, employing the solid-wall tube in the cable as a "pressure-line" between adjacent joints. Portable U-tube manometer outfits of various heights were made up, using oil as the fluid, and small pressure differentials are readily observed. If a large leak should be experienced pressure readings at joints taken by means of the conventional form of portable pressure gauge would be sufficiently indicative and be a faster procedure.



JOINT WIPING completed

In case loss of gas indicates a small leak—one not likely to have mechanically damaged the insulation or permitted moisture to enter—operating instructions provide that a cable can be kept in service pending a suitable system load or other conditions for its removal from service. Following a low-pressure alarm, dispatchers will notify the underground crew and feed enough gas into the cable to raise the pressure to about 12.5 psi. If a continuous supply is necessary to maintain pressure, that will be provided.

Minimum Gas Loss

Under normal operating conditions the gas supply valve is kept manually closed and the gas cylinders with their pressure regulators are not "floated" on the system. Keeping the supervisory function of the gas system effective, rather than loss of the inexpensive gas, is the principal reason for keeping the gas system tight. The loss of as much as a 200 cu.ft. cylinder per month would not be important from the cost of gas standpoint, but would be undesirable from other operating standpoints, due to frequent alarms and the accompanying attention of cable men, which would be required.

It has been observed that it takes about 12.5 cu.ft. (at atmospheric pressure) of gas to raise the pressure on one cable from 10.5 to 12.5 psi. at 25 deg. C.

These cables have already been carrying more than two-thirds rated load and have also been subjected to considerable variations in ambient temperature, all without any difficulties with gas pressures, although the pressure does rise and fall within permissible limits due to changes in load and ambient temperature.

Polyphase Metering Corrections by "Cosine Method"

Step-by-step procedure clarifies application of voltage and current transformer ratios and phase angles to watt-hour meter calibration for power and reactive registrations

H. G. YARRILL, Assistant District Meter Engineer Hydro Electric Power Commission of Ontario, Canada

THE cosine method for determining the errors due to instrument transformer phase-angle differences is a simple "step-by-step" method to find the final or "net angle" between the meter potential and currents.

The "cosine" of this net angle is then used as a multiplying factor, applied to some convenient assigned value of meter volt-amperes and the result compared with a value calculated for an ideal meter without such transformer errors.

The errors thus found can then be expressed as a "phase-angle correction factor" to be applied in arriving at the true multiplier for the meter readings, to convert meter watts, watt-hours or demands to true power values.

In using the cosine method all phase angle errors are expressed in terms of "degrees and minutes" lead or lag of the transformer secondary vectors to the primary vectors (see Fig. 1).

A.I.E.E. definitions state that a reversed secondary potential or current vector (*i.e.*, the metering vector) is considered + when it "leads" the primary vector and — when it "lags" the primary vector (Fig. 2).

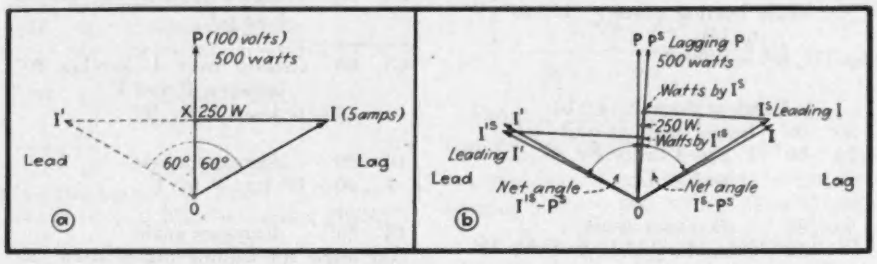


FIG. 1—Vectors evolved from conditions of ideal instrument transformers to those prevailing when these transformers have departures from nominal ratio and truephase opposition of primary and secondary values

(a) Watt-hour meter responds only to in-phase components of volts and amperes applied to it, *i.e.*, VA cos Ø = 250 watts.

(b) Potential transformer has secondary voltage lagging; current transformer has secondary current leading. True net angle at watt-hour meter is that between OP^s and OI^s for a lagging power factor of the load. For a leading power factor of load the secondary current I^s leads the actual load current, which, of course, leads the line voltage OP.

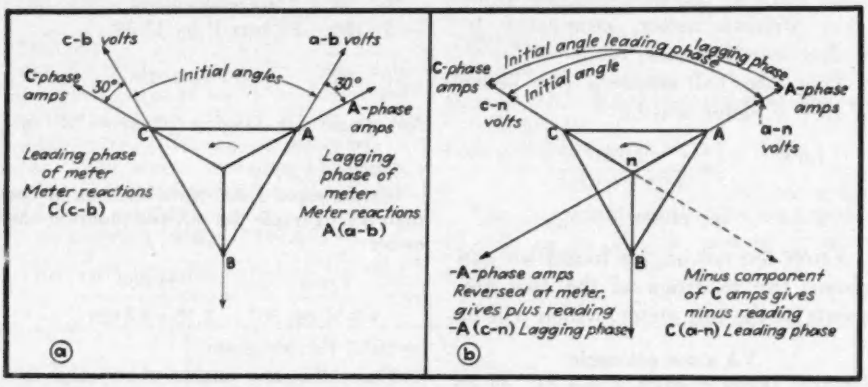


FIG. 2—Customary vector relations for three-phase metering at unity power factor (a) For kilowatt-hour metering; (b) For Kilovar metering

Examples of Cosine Method

Four typical examples are given as follows:

(1) 3-phase, 3-wire, K.W. meter. Load p.f. 93.97% I lagging 20°
(2) 3-phase, 3-wire, K.W. meter. Load p.f. 64.28% I lagging 50°
(3) 3-phase, 3-wire, K.X. meter. Load p.f. 93.97% I lagging 20°
(4) 3-phase, 3-wire, K.X. meter. Load p.f. 64.28% I lagging 50°

A three-phase wattmeter (two-element type) is really two single-phase meters, mechanically coupled together to give the algebraic sum of their respective torques.

For this reason it is necessary to determine the errors due to phase differences for both meter elements separately.

Meter vectors in Figs. 3, 4, 5 and 6 are shown for the separate meter elements.

The following transformer data are used through the examples given:

Potential Transformers:

Phase	Nominal Ratio	Ratio Correction Factor	Phase Angle Error
Leading	120/1	1.004	−1° (lag)
Lagging	120/1	1.006	−1° 30′ (lag)

Current Transformers:

Phase	Nominal Ratio	Ratio Correction Factor	Phase Angle Error
Leading	100/1	1.005	+40′ (lead)
Lagging	100/1	1.002	+30′ (lead)

High P. F. Example

Three-phase, three-wire kilowatt-hours. Load p.f. 0.9397 = (cos 20°) (Fig. 3):

Leading phase C (c−b)

30°	00′	Initial angle at unity p.f.
−20°	00	I′ lags I unity by 20° due to load p.f.
10	00	reduces angle
+	40	Secondary I^s leads I′ by 40′
10	40	increases angle
+ 1	00	Secondary P^s lags P by 1°
11°	40′	increases angle

Net angle leading phase = 11° 40′ (P^s to I^s)

Cos 11° 40′ = 0.9816

Lagging phase A (a−b)

30°	00′	Initial angle at unity p.f.
+20	00	I′ lags I unity by 20° due to load p. f.
50	00	increases angle
−	30	Secondary I^s leads I′ by 30′
49	30	decreases angle
− 1	30	Secondary P^s lags P by 1° 30′
48°	00′	decreases angle

Net angle lagging phase = 48° 00′ (P^s to I^s)

Cos 48° = 0.6691

For convenience take a value of 1,000 watts as the total reading of an ideal 3-phase meter, connected to perfect transformers.

Then the volt-amperes per phase of such a meter will be

$$\frac{1,000}{\sqrt{3} \times \cos 20^\circ} = \frac{1,000}{1.73 \times 0.9397} =$$

615.1 VA per phase

From the net angles found we can obtain the readings of the two elements of the test meter, which will be

VA x cos net angle

Leading phase − 651.1 x cos 11° 40′ = 615.1 x 0.9816 = 603.78

Lagging phase − 651.1 x cos 48° 00′ = 615.1 x 0.6691 = 411.56

The sum of these two is the total reading of the meter = 1,015.34 watts.

This is a + error on the meter, so the correction factor must be below unity:

$$= \frac{1,000}{1,015.34} = 0.98489$$

The true multiplier for the meter can now be found; it will supersede the nominal multiplier of 12,000.

Nominal ratio × ratio correction factor × phase-angle correction factor.

Since there are two sets of transformers used we must average the true ratios and then multiply by the phase-angle correction factor:

Leading phase − 120 x 100 x 1.004 x 1.005 = 12,108.24

Lagging phase − 120 x 100 x 1.006 x 1.002 = 12,096.14

Average = 12,102.19

Multiplying by 0.98489 to obtain the true multiplier to be used for conversion of meter watts to kilowatts:

12,102.19 x 0.98489

True multiplier = 11,919.342

Low P. F. Example

Three-phase, three-wire K.W. Load p.f. 0.6428 = (cos 50°) (Fig. 4):

Leading phase C (c − b)

30°	00′	Initial angle at unity p.f.
50	00	I′ lags I unity by 50° due to load p.f.
20	00	Crosses over I, leaving 20° between P and I′
−	40	I^s leads I′ by 40′
19	20	decreases angle
− 1	00	P^s lags P by 1°
18°	20′	decreases angle

Net angle for leading phase = 18° 20′ (P^s to I^s)

Cos 18° 20′ = 0.9492

Lagging phase A (a − b)

30°	00′	Initial angle at unity p.f.
+50	00	I′ lags I unity by 50° due to load p.f.
80	00	increases angle
−	30	I^s leads I′ by 30′
79	30	decreases angle
− 1	30	P^s lags P by 1° 30′
78°	00′	decreases angle

Net angle for lagging phase = 78° 00′ (P^s to I^s)

Cos 78° = 0.2079

On the same 1,000-watt basis as in the high p.f. example the VA per phase at the meter

$$= \frac{1,000}{\sqrt{3} \times \cos 50^\circ} = \frac{1.000}{1.73 \times 0.6428}$$

= 890.3 *VA* per phase

From the net angles above the test meter reading will be

Leading phase 890.3 x 0.9492 = 844.97 watts

Lagging phase 890.3 x 0.2079 = 185.09 watts

The sum of these two equals the total watts indicated by the test meter = 1.030.06.

This is a + meter error as in the previous example so the correction factor will be

$$\frac{1,000}{1,030.06} = 0.9708$$

The average ratio being the same as before − 1,2102.19

True multiplier = 12,102.19 x 0.9708 = 11,748.8

Application to Kilovar Metering

The function of a kilovar meter is to register the reactive component of the load.

However, it is obvious that any meter used to measure kilovar-hours must still have the same characteristics as a meter used for measuring kilowatt-hours. In fact, both such meters can be identical, the only change being the method of connecting them in the circuit.

The reactions of the potential and current coils of kilovar meter will still respond to the in-phase component of the volts and amperes applied to it.

High P.F. Kilovars

Three-phase, three-wire K.X. Load p.f. 0.9397 = (cos 20°) (Fig. 5):

Leading phase C (a − n)

120°	00′	Initial angle at unity p.f.
− 20	00	I′ lags I unity by 20° due to load p.f.
100	00	reduces angle
+	40	Secondary I^s leads I′ by 40′
100	40	increases angle
+ 1	00	Secondary P^s lags P by 1°
101	40	increases angle
+180	00	Reversal of I^s vector
281°	40′	increases angle

Net angle between I^s reversed and P^s = 360° − 281° 40′ = 78° 20′ (P^s to I^s)

Cos 78° 20′ = 0.2193 for leading phase

Lagging phase − A (c − n)

120°	00′	Initial angle at unity p.f.
+ 20	00	I′ lags I unity by 20° due to load p.f.
140	00	increases angle
	30	Secondary I^s leads I′ by 30′
139	30	decreases angle
− 1	30	Secondary P^s lags P by 1°
138	00	decreases angle
+180	00	Reversal of I^s vector
318°	00′	increases angle

Net angle between I^s reversed and P^s = 360° − 318° = 42°

Cos 42° = 0.7431 for lagging phase.

For a secondary load of 1,000 watts the "ideal" meter must register the reactive component.

In this case it will equal 1,000 tan 20° = 1,000 x 0.36397 = 363.97 reactive volt-amps.

The volt-amperes applied to the test meter are the same as in the initial example, namely, 615.1 VA.

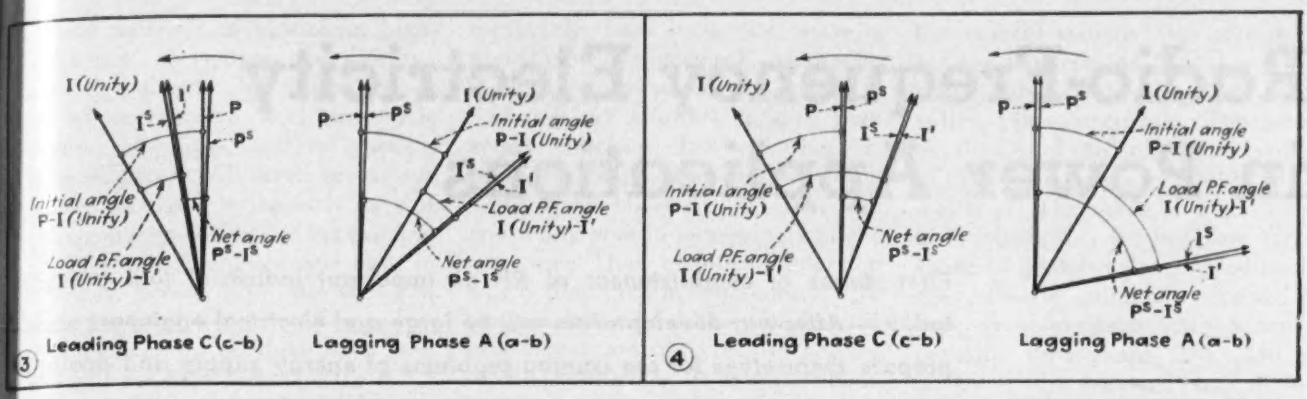


FIG. 3—Example of instrument transformer corrections to watt-hour registrations for relatively high load power factor (0.9397 corresponding to 20 deg. lag)

FIG. 4—Example of corrections to watt-hour registration for relatively low power factor (0.6428, corresponding to 50 deg. lag)

The readings of the test meter are therefore

Leading phase — 615.1 x 0.2193 = 134.99
Lagging phase — 615.1 x 0.7431 = 457.08

In the case of a kilovar meter at this load power factor the leading phase gives a "minus" registration. The total reading is therefore

Leading phase — 134.99
Lagging phase + 457.08

+ 322.09 RVA by the test meter

True RVA=363.97 as indicated by an ideal meter.

The test meter error is a minus one so the correction factor for transformer error will be

$$\frac{363.97}{322.09} = 1.13$$

The average ratio is the same as before — 12,102.19
True multiplier = 12,102.19 x 1.13
= 13,675.47
The apparent multiplier is 12,000.

Low P.F. Kilovars

Three-phase, three-wire K.X. Load p.f. 0.6428 = (cos 50°) (Fig. 6):

Leading phase C (a − n)

120°	00′	Initial angle at unity p.f.
− 50	00	I′ lags I unity by 50° due to load p.f.
70	00	decreases angle
+	40	Secondary I^S leads I by 40′
70	40	increases angle
+ 1	00	Secondary P^S lags P by 1°
71°	40′	increases angle

Net angle between P^S and I^S = 71° 40′
Cos 71° 40′ = 0.3311 for leading phase

Lagging phase — A (c − n)

120°	00′	Initial angle at unity p.f.
+ 50	00	I′ lags I unity by 50° due to load p.f.
170	00	increases angle
−	30	Secondary I^S leads I by 30′
169	30	decreases angle
− 1	30	Secondary P^S lags P by 1° 30′
168	00	decreases angle
+180	00	Reversal of I^S vector
348°	00′	

Net angle between P^S and I^S = 360 − 348 = 12°
Cos 12° = 0.9781 for lagging phase.

For 1,000 watts secondary load the reactive volt-amperes at 0.6428 p.f. will equal 1,000 tan 50°
= 1,000 x 1.1918 = 1191.8 RVA

The volt-amperes applied to the test meter are the same as in the corresponding low p.f. example for kilowatt-hour metering, namely:

$$\frac{1{,}000}{\sqrt{3} \times \cos 50°} = 890.3 \text{ VA}$$

From the net angles obtained above the test meter reading will be

Leading phase — 890.3 x 0.3311 = 294.78
Lagging phase — 890. 3 x 0.9781 = 807.80

At this load power factor both phases of the kilovar meter give "plus" readings. The sum of these two values is therefore the total reading shown by the test meter.

294.78 + 807.80 = 1,102.58 RVA
True RVA = 1,191.80 RVA

This is again a minus error of reading in the test meter and the correction factor becomes

$$\frac{1{,}191.80}{1{,}102.58} = 1.08$$ phase-angle correction factor

Average ratio being the same as before — 12,102.19
True multiplier = 12,102.19 x 1.08
= 13,070.26

The apparent multiplier is only 12,000, as in all the preceding examples.

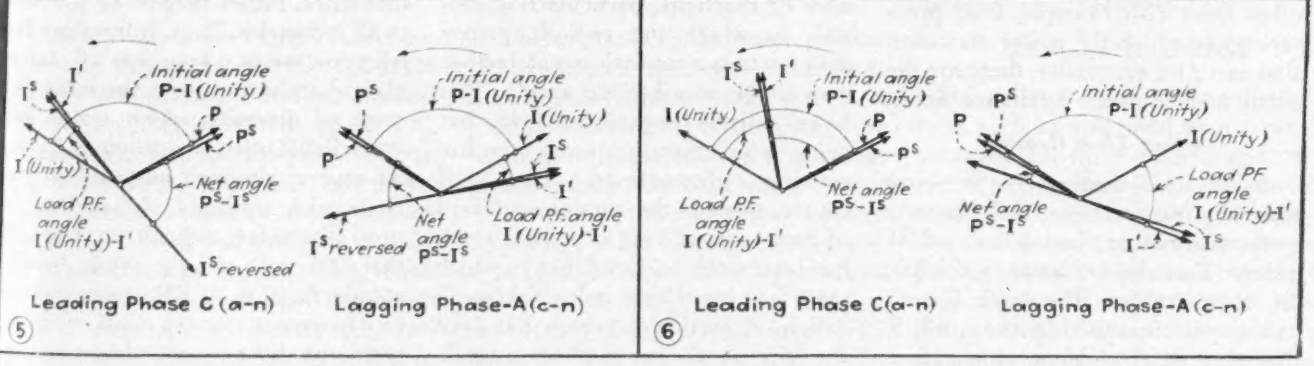


FIG. 5—Example of corrections to reactive registration for relatively high power factor of 0.9397

FIG. 6—Example of corrections to reactive registration for relatively low power factor of 0.6428

Radio-Frequency Electricity in Power Applications

First stages of establishment of RF as important industrial tool are seen today — After-war developments will be large and electrical engineers should prepare themselves for the coming problems of energy supply and operation

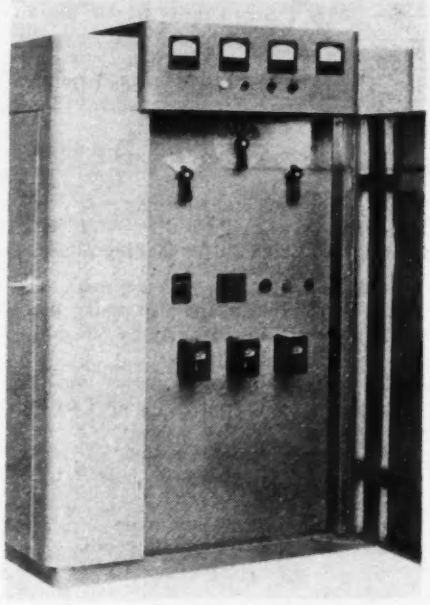
JOHN P. TAYLOR, RCA Manufacturing Company, Inc., Camden, N. J.

ALTERNATING - CURRENT ENERGY at radio frequencies and in significant power quantities is today at work in many important jobs throughout American industry. A year ago such a statement could not have been made, and only two or three years ago it would have been—and in fact the prediction of it was—labeled "dreaming."

As of today, the more important uses of RF power are in the hardening of ferrous metals (particularly where very thin hardened surfaces are required), the welding of metal and glass pipe, the annealing of non-ferrous as well as ferrous metals, the flowing of tin in tinplating, various brazing and soldering jobs, the detonation of explosive rivets, the gluing and laminating of wood, the preheating of molding materials, the forming of plastics, the curing of rubber and the baking of abrasive wheels. Diverse as these are, they have two things in common: First, they are all in the industrial field and, second, they are all applications in which RF power is used to produce heating. Outside of the manufacturing industry there are other fields (for example, food processing) in which RF power may soon find use. And eventually, there are the retail and domestic appliance fields.

Other Than Heating

Aside from heating by RF—now generally referred to as Radiothermics—there are other possible uses of RF power. There is, for instance, the field of Chemotronics. The term Chemotronics was first used by the late I. R. Baker of RCA to denote applications involving the use of electronically created RF power in promoting processes or reactions, particularly chemical, in which the radio-frequency power acts as a catalytic agent (rather than simply as a heating agent). This is an entirely unexplored field, but one in which there are some faint but enticing glimmerings. Then, of course, there is the omnipresent field of Supersonics. This is a field which has been much explored, but in which there has been little industrial application. A particular reason has been the lack of efficient applicator mechanisms. There are wartime developments which may markedly alter this situation and bring sonic frequency (SF) power into as wide use as RF power. In a part of the range the frequencies of SF power and RF power are the same, and the generating (and transmission) equipment will likely be similar.



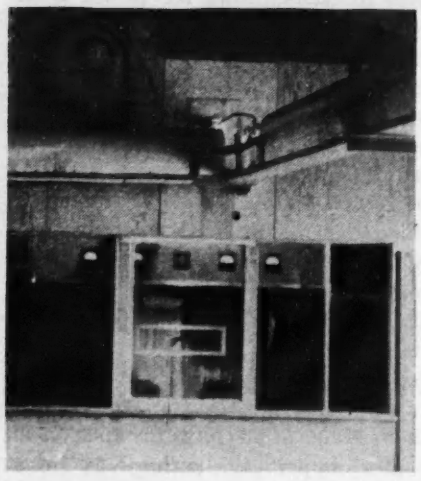
RF ENERGY SUPPLY is developing most rapidly in "package" units.

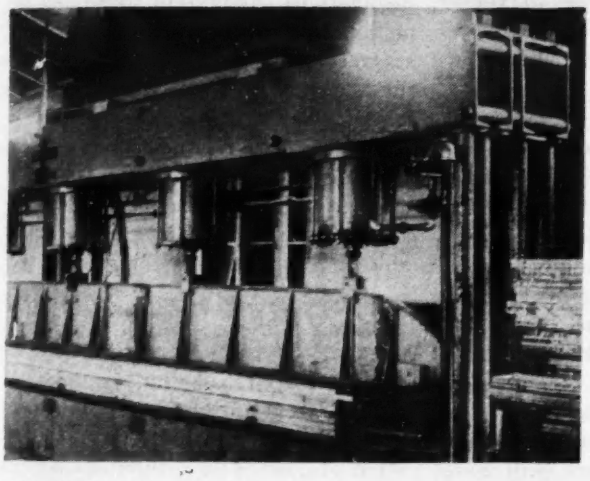
This is a 15-kw. unit. Tuning controls and time delay, overload and other relays are set for performance desired and door is normally closed during operation, which is effected by means of exterior push buttons such as those below the meters or, quite often, at a remote point.

With all of these RF applications developing rapidly, the electrical engineer may well begin thinking of the problems they will bring. It is likely that many of these will bear a resemblance to the problems which arose in the early days of the development of what are now ordinary uses of electricity. Most prominent of these will be the problem of distribution. In fact, the question of a single large producing unit versus a multiplicity of smaller units has already arisen. In many ways this would seem analogous to the original a.c. distribution problem, which, of course, was settled in favor of complete centralization. There are, however, marked differences and these present imposing difficulties. For instance, applications of RF are specialized—industrially they present a "vertical" pattern—that is, they tend to concentrate in particular industries, rather than to be common to all industries. Thus, inter-plant distribution seems a long way off. Intra-plant distribution lacks the large element of diversity which makes 60-cycle distribution so attractive. Again, RF power, although adaptable to various trick methods of handling, is presently more difficult to transmit than 60-cycle power. And, finally, standardization of RF power even as to frequency, much less voltage, seems at the moment almost impossible of achievement.

There are three more or less funda-

mental methods of producing high-frequency alternating (oscillatory) electric current: by discharge of stored energy, by electro-magnetic rotating machines, and by vacuum tube oscillators. All three, in various forms, were used in the early days of radio communication, but the two first are now considered obsolete and, in fact, have passed out of use except in a few isolated instances. For industrial applications all three have been and still are used, although the trend gives every indication that history will repeat. Quenched (spark) gap RF generators are in use today in sizes up to 30 kw. and frequencies to 300 kc. They have the advantage of low first cost, but are limited as to size and frequency, are relatively inefficient, often cause interference, and require a considerable amount of maintenance. Rotating machines have been by far the most used high-frequency producing units to date. Most of these operate at frequencies below 10,000 cycles, although a few have been built for frequencies up to about 15,000 cycles. The latter frequency appears to be near the top practical limit for large machines. (Radio engineers, having tried for years to build bigger and better Alexanderson alternators, can speak with some authority on this point.) Thus, although rotary machines, which are efficient and relatively cheap converters, do a good job in the frequency range of 400 to 15,000 cycles, there is little likelihood of their use in the range usually referred to as radio frequencies. Vacuum tube oscillators, in contrast, can easily be built for any frequency from a few cycles to 500 megacycles (and in special forms to even higher frequencies). At present they are somewhat more expensive in first cost per kilowatt installed than rotary machines; however, they require less maintenance and have such universal application that they are now being built in increasingly larger quantities. Thus, quantity production will in time (and in combination with the eventual availability of improved tube types) probably reduce the cost of tube oscillators. It is quite likely that before too long these will be competitive in price with rotary machines. Such a development would lead to a gradual replacement of the latter just as tube rectifiers have gradually replaced rotary d.c. converters.





RF energy used in making laminated wood spars for airplane construction is produced at one point—unit visible through window—and used by three presses, one of which is shown in picture at left. While one press is heating the two others are being loaded and unloaded. Energy is "piped" to presses in lines at top of picture above. When one press is heating, power supply to the two others is cut off by a manual switching arrangement.

BENEFITS of diversity appear

A vacuum tube oscillator of the type used for RF heating is essentially a relatively simple device. It utilizes one or more standard three-element radio tubes similar in most respects to those in a radio receiver, but usually of much larger size.

A vacuum tube oscillator requires two current sources. One of these is for the filaments of the tubes. Ordinarily this is low-voltage (5 to 25 volts), 60-cycle current. The power required is of the order of 10 percent of the output power capability of the oscillator. The other is a source of high-voltage d.c. for the plate (from 1,000 to 25,000 volts, depending on size). This is ordinarily obtained by stepping up available 60-cycle supply (usually three-phase 220, 440 or 2,300) to the required amount and rectifying with hot-cathode mercury-vapor rectifier tubes. The power required from this source will be 125 to 150 percent of the output power rating of the oscillator, the difference representing heat losses in the anode and tube envelope. There will also be external circuit losses, so that generally speaking the over-all efficiency of a vacuum tube oscillator will not be greater than 75, and it may be as low as 50 percent.

There is one oscillator arrangement in which the separate high-voltage rectifier can be eliminated. This is the so-called "self-rectified" oscillator, in which two tubes are connected in a manner sometimes termed "back-to-back." In this arrangement the first tube operates during the first half of the cycle, while the second tube is idle. On the second half of the cycle the second tube operates and the first idles. Since higher peak filament emission is required in this arrangement (for the same power output) and filament emission is ordinarily a limiting factor, this circuit does not provide much economy. It does allow of some circuit and mechanical simplifications, and for that reason is often used in smaller size RF generators. (Diathermy machines are an example.) It may in the future be used on higher-powered installations if tubes become available.

Alternative Possibilities

RF generators of the vacuum-tube type, such as described above, divide naturally into three main components, *viz.*, a step-up transformer to provide the high voltage, a rectifier to change this to d.c. and the oscillator proper. This breakdown leads to a consideration of alternative distribution possibilities. One such possibility is that of supplying a single large transformer and wiring high-voltage a.c. to the separate generators. Presumably this

would provide a saving in transformer cost and, in large installations, in transmission copper as well. Such savings, however, would probably be offset by an increase in control circuit costs. At present such control is exercised in the primary of the step-up transformer, with voltage change accomplished either by taps on the primary, by change from delta to wye connection, or by an induction regulator. To exercise the same control at high voltage would be considerably more expensive. And, of course, the system would lack flexibility where units of various sizes were required.

Another possible method of accomplishing a certain amount of centralization would be to provide a single large rectifier and to wire high-voltage d.c. around the plant. This would undoubtedly greatly reduce rectifier costs and would be more likely to provide over-all cost reduction; however, it would have the same disadvantages as to control and lack of flexibility found in the high-voltage a.c. distribution system.

Coming Together

These as well as other less obvious systems of simplifying and centralizing RF power supplies have been carefully considered by radio engigineers in connection with installations made and planned to date. Some of them have even been tried in a small way. For instance, one west coast installation consists of a single 600-kw. rectifier supplying high-voltage d.c. for two 300-kw. (input rating) oscillators. Such an arrangement was chosen for purposes of economy (because the available rectifier tubes would give 600-kw. as easily as 300-kw.) rather than distribution, the units being adjacent to each other. In another plant three separate (and different) operations requiring RF power are fed from a single oscillator. In this case, however, only one operation is fed power at a time, a schedule having been set up such that required production can easily be met by this means. Lines about 50 ft. long run from the oscillator to each operation. A simple hand-switching arrangement provides for selection of line to be fed. In still another installation—still in the planning stage—eight operations will be fed simultaneously. This will not, however, provide "diversity" as the unit will have to be large enough to supply all eight simultaneously.

The three installations just mentioned are the exceptions rather than rule. Most installations made so far consist of a single unit or of a multiplicity of single units, and at the moment there are no signs of a change in this trend. Nevertheless the advantages of distribution, once achieved, are so great that it seems reasonable to suppose that eventually some system will evolve.

"Piped" Electricity

Whether or not centralized RF power supplies materialize, the problem of transmitting RF power is always present. Only in very favorable cases can the generator be located immediately at the work point. More often it will be 20, 30 or 50 ft. away—and 50 ft. of RF transmission may be anything but a simple design and construction problem. In particular will the problems involved be troublesome to electrical engineers whose knowledge or experience is limited to low-frequencies. For example, RF energy is "piped" rather than "wired" from source to load. The means of piping may be a concentric transmission line consisting, in a typical instance, of an outer copper pipe perhaps 2½ in. in diameter within which is coaxially supported on insulators another copper tube perhaps ½ in. in diameter.

Again, it may consist of a square metal duct within which a single copper conductor is mounted on stand-off insulators. In either case the inner conductor is the high-voltage or "hot" lead, while the outer pipe or the duct is the ground return. Another problem is that for minimum losses (and minimum radiation) the impedance of the load must match the impedance of the RF line feeding it. This usually requires the use of some sort of impedance-matching network at the load end. But such a network will have small resemblance physically to typical low-frequency networks. Inductances, for instance, are likely to be short pieces of copper tubing arranged in a U-shape with a shorting bar to give variation. Should the industrial uses of RF expand into the ultra-high frequencies the transmission lines may become merely "waveguides" and an order of phenomena strange even to radio men may ensue.

War Helps and Hinders

Although the war effort is rapidly adding to the applications of radio-frequency power—new applications appearing almost every day—it is at the same time restraining the growth of RF and, in particular, preventing its mass application. RF heating is being applied today almost exclusively to specialized war production problems, where it is of great advantage in speeding up production or in betterment of product. Unfortunately radio equipment is one of the most critical of war items and radio manufacturing and development facilities are extremely limited. Not only has this tended to prevent mass application of equipment already designed, but also it has retarded the development of new and much larger equipments for which the need has been indicated. As a result, in this, as in many other fields, removal of the restraints of wartime will be followed by a tremendous expansion, for which all those concerned should be prepared.

Probably one of the first things to come after the war will be larger vacuum tubes. Present tubes are capable of outputs of the order of 100 kw. Designers prefer to use not more than two tubes per oscillator, giving a maximum practical oscillator output of about 200-kw. Already there are needs for 500-kw. and 1,000-kw. installations. At present these can be met only by paralleling (in effect) several units. Actually there are no inherent limitations on tube sizes, and the eventual availability of single tubes of 500 kw. or better capacity is indicated. Design of such tubes, however, will reqiure engineering time and talent which will hardly be available before the end of the war.

Costs Will Come Down

Other after-the-war probabilities are lower first cost and lower power cost. Present installations have been made with only a secondary consideration of costs. Peacetime installations will place cost first. In many applications of RF the power consumed is so small as to play little part in over-all operating cost, while the cost of the equipment itself is little, if any, more than that of the equipment it replaces. However, in comparison with the ordinary cost of electricity for industrial use, which is the way most people will think of it, RF power is quite expensive. The cost of installed capacity ranges from about $1,000 per kilowatt for installations of a few kilowatts power down to $400 for those over 100 kw. Over-all costs per kilowatt-hour of RF energy (including

depreciation at a fairly rapid rate) range from 8 cents down to 5 cents for the same size installations. Obviously there are many industrial heating applications in which the use of RF power cannot be justified at these costs.

Drying of large volumes of material—an application for which RF otherwise has many advantages—is one of these. However, the economics of some of the drying applications are such that they are already borderline. Thus a relatively minor adjustment downward in costs would definitely open these fields to radio frequency. That such cost reductions will come is certain—the degree and the time are the unknowns.

It would be false, of course, to give the impression that the conditions of wartime are the only restraints on the growth of RF power applications. There still remain many technical benchmarks to be established, many questions to be answered. A brief survey of the history of RF heating and of present practices shows that much remains to be done.

While the heating of all kinds of materials is grouped under a single heading—Radiothermics—there are actually two quite different methods used, depending on whether the materials to be heated are metals (conductors) or non-metals (non-conductors). Metals are heated by the flow of radio-frequency currents induced in them by means of magnetic flux coupling—hence the term "induction heating." Non-metals are heated by placing them beween large metal plates or electrodes so that in effect they form the dielectric of a condenser. Dielectric losses cause the material to be heated, hence the term "dielectric heating."

On the Surface

"Induction" heating is not new. For something like twenty-five years ordinary 60-cycle currents and currents at frequencies around 500 cycles (once called "high-frequency" current!) have been used in electric furnaces for melting metals. Just a few years ago developmental work was undertaken to capitalize on the particular skin effect characteristic of high-frequency induction by which the induced currents concentrate themselves at the surface of the object metal. From this work came the processes of surface hardening by high-frequency heating now quite widely used. Frequencies used in these processes range from 3,000 cycles up to 300 kilocycles. Depth of current penetration (and hence, of heating) in the object metal is an inverse function of the applied frequency (providing that the heating is done so quickly the heat conduction inward is not a factor). Thus the lower the frequency, the greater the mass of metal heated and the longer it takes to bring it up to temperature (for the same power input).

For some surface-hardening purposes this greater penetration is a drawback. For example, a connecting rod bearing surface so processed might have an entirely satisfactory surface hardness, while the metal just below the surface would have been actually weakened by having been subjected to part of the heating. This disadvantage makes desirable the use of higher frequencies. Higher frequencies (of the order of 1 megacycle) also make possible a process in which no external quenching is required. This is accomplished by heating a very thin skin very quickly (in less than a second) so that on removing current the cold metal behind the heated surface immediately cools the latter. Scaling and distortion are much reduced and the transition zone which occurs with low-frequency heating is nearly eliminated. Unfortunately these high-speed heat processes are quite critical. The choice of frequency is intimately tied in with the time cycle, the power available and constitution of the object metal.

HAND TOOL requires short-distance transmission of RF through extension cord. This RF "gun" is used to spot-glue layers of veneer to a wooden mandrel. Several layers of veneer are shaped and held by this method, after which the assembly is cooked under pressure in an autoclave to become a fully stressed molded skin. This technique is used in making molded plywood aircraft. The RF gun obviates the use of wire staples, which had to be removed, leaving holes in the skin.

Knowledge of the manner in which various factors affect induction heating at radio frequencies is not yet complete by any means and it will probably take considerable time to establish the best frequencies for desired results with various steels and alloys, as well as different shapes and sizes of heated objects. Similar, although less critical problems exist with reference to applications of RF induction heating for operations such as soldering and brazing.

Inside Out Heating

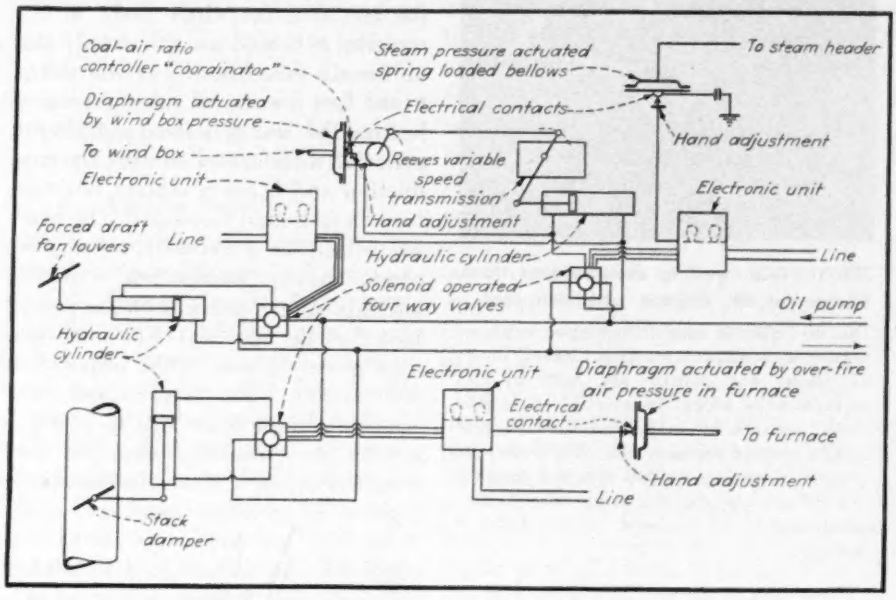
In "dielectric" heating by radio-frequency power the advantage lies in the fact that the whole body of the material is heated simultaneously and uniformly throughout (as contrasted to the fact that in all other means of heating the heat generated outside the material must travel inward by conduction and hence a certain non-uniformity is bound to occur). The heating effect, as previously noted, depends on the "conduction" current, and this in turn depends on the power factor of the material. For materials with power factors of the order of a few percent—such as wood and most plastics—frequencies of 2 to 10 megacycles are ordinarily used. For materials with lower power factors much higher frequencies must be used. Moreover, size and shape of the material also are factors in determining the optimum frequency for a particular operation. As a result, frequencies from 2 to 200 megacycles are used in the dielectric heating fields.

This résumé, brief as it is, will serve to indicate some of the problems in the field. There are others. It is obvious that there is not yet—and there may never be—any effective standardization of radio frequencies for industrial heating applications. For a long time, and perhaps always, this condition alone will stand in the way of any such realization of the benefits of diversity as has been accomplished in the familiar 60-cycle electricity supply system. In other words, while high-frequency distribution may become a reality in small-scale systems, it probably never will approach in extent what is today thought of as an industrial power distribution system.

Electronic Circuits Actuate Automatic Combustion Control

Illinois generating station applies electronic circuit to combustion control — Three units regulate supply of coal and air to furnace to give constant steam pressure and adjust stack dampers to give constant furnace pressure

K. D. KNOBLOCK, Chief Engineer, American Utilities Service Corporation, Chicago, Ill.



SCHEMATIC ARRANGEMENT of electronic combustion control system

ELECTRONICS has a very logical new field of application in automatic combustion control for steam-generating plants and in the control of individual boilers at such plants. In its most elemental form combustion control consists of automatically regulating the supply of coal and air to the furnace of a boiler so as to maintain a constant steam pressure and a constant furnace air pressure (or vacuum) through the regulation of boiler stack dampers. Uniform and efficient combustion results from maintaining a constant furnace pressure, regardless of the rate of combustion, as less excess air is admitted to the furnace. The combination of coal and air feed controls, plus furnace pressure control, results in much better efficiency than could be obtained by manual operation. These are jobs that can be handled advantageously by electronic controls.

In preparing plans for installing a new stoker-fired boiler in the Savanna, Ill., electric generating plant of Northwestern Illinois Utilities it was decided to consider electronic controls of some sort which would give the simple form of automatic combustion control sought. After a diligent search in a very limited field, an electronic control was found which seems to suit our requirements of (1) simplicity and ease of operation and maintenance, (2) a constant steam pressure with no tendency of the controls to "hunt," (3) a uniform and high percent CO_2 in the stack gases regardless of load conditions and (4) low operating and maintenance cost.

Three Electronic Units

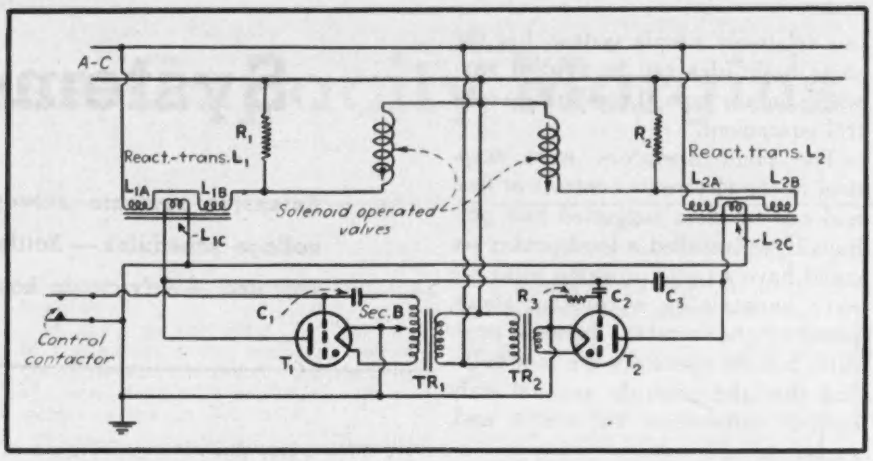
The combustion control selected utilizes three electronic units, one of which controls both the coal and primary air supply to the furnace, the second supplements the first and keeps wind box pressure within desired limits, while the third operates the stack damper to maintain a constant air pressure in the furnace.

Circuits of the three electronic units are identical. Upon closing or opening an electrical contact the electronic circuit actuates one or the other of a pair of solenoid valves through which oil is delivered under pressure to either side of a hydraulic piston. Oil required to operate the pistons is delivered by a small motor-driven centrifugal pump.

Two of these electronic units are associated with the "master steam pressure controller" of the combustion control system. This master controller regulates coal and primary air supply to the furnace and maintains wind box pressure within limits. Variations in boiler steam pressure act on a bellows to open or close electrical contacts which act on the grids of one of the electronic units, actuating its associated hydraulic piston as explained. This piston moves the adjusting lever of a Reeves variable-speed transmission, through which an electric motor drives the chain grate stoker.

A second electronic unit and hy-

draulic cylinder, operated from this same master steam pressure controller, moves the lever adjusting the louvers on the discharge side of the forced-draft fan to vary the volume of air admitted to the furnace and yet maintain wind box pressure within variable limits. To accomplish this a "co-ordinating" device, operated by the Reeves variable-speed transmission-adjusting lever through a mechanical linkage, adjusts the forced-draft fan air pressure limits between which the fan operates. The forced-draft fan is "coordinated" to the stoker operation to deliver air properly proportioned to the amount of coal being delivered to the furnace.



SOLENOID-OPERATED VALVES are actuated by electronic circuit in one direction when pressure falls below selected value and in other direction when pressure rises above critical. Tubes are FG-17 or comparable three-element tubes

Stack Damper Control

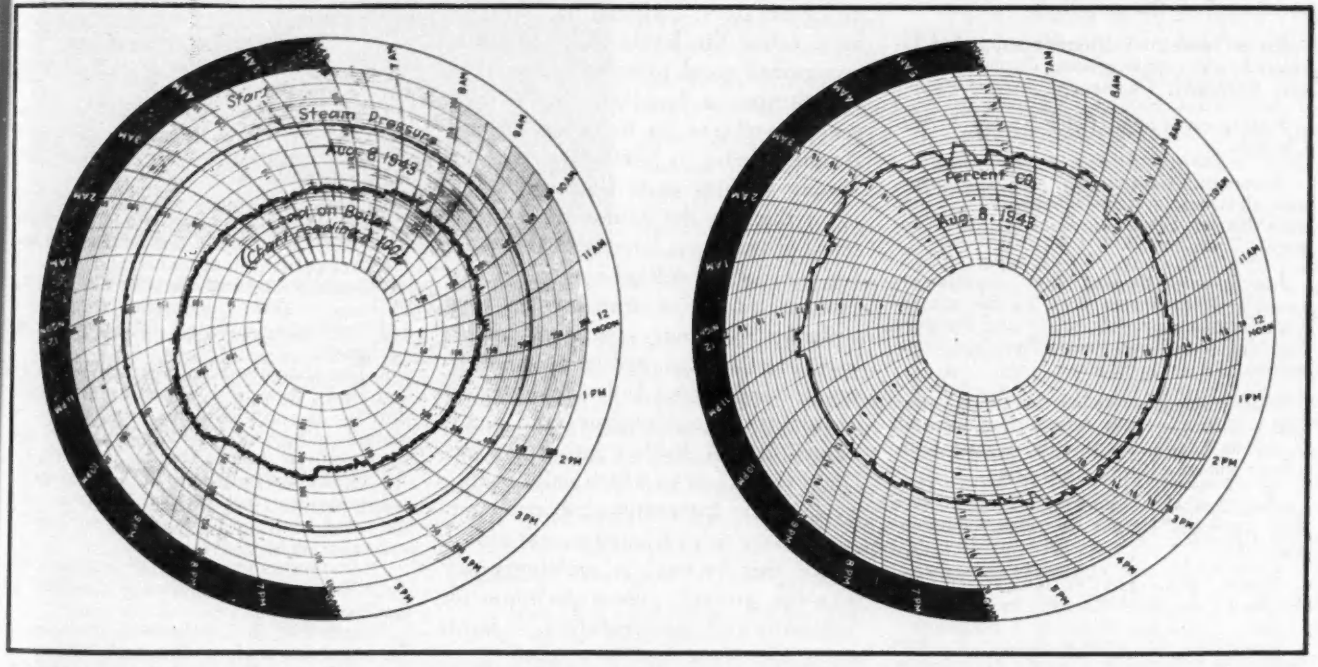
The third electronic control unit, which adjusts the position of the stack damper, is identical with the steam pressure master control unit except that it consists of a larger spring-loaded diaphragm to which is attached a silver contact which opens or closes a circuit as the over-fire air pressure in the furnace increases or decreases. Adjustments in pressures which are desired are made by means of small indicating and adjusting levers which are mounted on the boiler instrument panel. Actually the adjustment consists of moving the master controller electrical contacts closer together or farther apart.

Shown is a simple one-line diagram of the electronic combustion control hook-up, also the electrical circuit showing the function of the electronic tubes, which act essentially as valves to control the flow of current to operate the two electric control motors.

Controls are very simple, compact and operate smoothly. The accompanying steam pressure chart shows that a practically constant steam pressure is maintained. A CO_2 chart, also shown, reveals a uniformly satisfactory combustion condition, in spite of the sizable load variations indicated. Initially, electric motors were used to operate the Reeves transmission-adjusting lever and the forced-draft fan louver-operating lever, but the operating cycle of the motors was too long and it was difficult properly to coordinate the operation of the forced-draft fan to the chain grate stoker. Substitution of a mechanical system, consisting of hydraulically operated pistons, has proved to be entirely satisfactory.

Reasons for Choice

We decided on electronic controls because they appeared to be simple, require very little maintenance and are capable of maintaining a practically constant steam pressure. Undoubtedly many refinements are possible on future electronic combustion control jobs, which we do not have on



CONTROL maintains substantially constant steam pressure in spite of sizable variations in boiler load (left)
Co_2 chart indicates satisfactory combustion under electronic control (right)

our relatively simple system, but the same basic idea can be applied anywhere on any type of combustion control equipment.

The plant operators were skeptical of the electronic controls at first and one of them suggested that perhaps if we installed a loudspeaker we could have a radio program while we were maintaining a constant steam pressure and constant furnace pressure, but the operators are now satisfied that the controls are not only entirely satisfactory but simple and. so far, trouble-free.

List of Major Equipment

Savanna Generating Plant Boiler Installation

Boiler—60,000-lb.-per-hour, 250-psi., 550 deg. F., 4-drum Adams water tube boiler with complete furnace water walls, economizer, venturi type self-supporting stack. Lasker Boiler & Engineering Co., Chicago.

Stoker—11 x 16-ft. 6-in. motor-driven chain grate stoker with separately operated over-fire air fan. LaClede Stoker Company, St. Louis, Mo.

Boiler Feed Pump—120-g.p.m., 300-psi., 4-stage dual-drive boiler feed pump operated by 40-hp. motor and Murray steam turbine. Dayton-Dowd Pump Company, Quincy, Ill.

Forced-Draft Fan—Class 2A 28,000-c.f.m. at 2½-in. water column driven by 20-hp., 1,200-r.p.m. motor. Clarage Fan Company, Kalamazoo, Mich.

Induced-Draft Fan—No. 100 type I induced-draft fan. Combination fan casing and venturi stack base. Prat-Daniels Corporation, Port Chester, N. Y.

Boiler Setting—Sectionally supported insulated wall construction. Furnace Economy Company, Chicago.

Setting contractor. Peter Knowe & Son, Chicago.

Automatic Combustion Control—Three-unit electronic system with hydraulic cylinders. Hurley Electronic Controls, Inc., Chicago.

Instruments—Boiler plant instruments panel and flow meter, draft gauges, recording thermometers, CO_2 meter and Reliance Eye-Hye water level gauge. Republic Flowmeters Company, Chicago.

Coal Conveyor—Redler horizontal drag flight conveyor with televel flow control. Stephens-Adamson Manufacturing Company, Aurora, Ill.

Ash Conveyor—Steamatic vacuum type ash conveyor. United Conveyor Company, Chicago.

Valves, Pipe and Fittings—George B. Limbert Company, Chicago, and others.

Insulation—85 percent magnesia block insulation. Standard Asbestos Manufacturing Company, Chicago.

System-Voltage Pr

Extensive systems surveyed to establish basis for swing voltage schedules — Bottlenecks circumvented — Benefits enumerated — Advice on how to "sell" and institute a program*

IN THE early days the conception of system-voltage planning was largely that of working from the generating station outward to the extremities. It is not surprising that, even today, there may be some generating-station superintendents who take pride in pointing to a straight-line chart of station-bus voltage and who espouse this principle of operating their station. Nevertheless, those now responsible for system-wide planning recognize customer-service voltage as the level of reference from which to develop facilities and practices for system-wide voltage determination.

Power systems vary extensively in such features as geographic spread, prevailing distance of transmission, load density, and calibre. flexibility and extent of facilities.

On some of the older systems there still may be in use large amounts of equipment, particularly transformers and generators, designed for top voltages below the levels that constitute recognized good practice today, thus constituting a handicap in holding service voltages up to needed levels. Again, there is extensive variety among systems as to types of equipment that, in the course of the system's growing up, have been provided for purposes of voltage control. These include range of transformer taps (whether or not operative under load), bus-voltage regulators, synchronous condensers, individual feeder regulators, shunt reactors and shunt capacitors. A further important factor is the extent to which neighboring systems are interconnected and operated under co-ordinated supervision.

All this variety, in an emergency like the present, puts a premium on ingenuity and resourcefulness in hunting down new versatilities and margins for increasing the use factor of present facilities, to the end of keeping voltages within limits necessary for adequate service. Undoubtedly, the most readily available single device for service-voltage control is the compensating or swinging of generating-station voltage with the load.

Advantages of Compensation

If inadequate service-voltage levels are being encountered in taking on increased loads, there may be good possibilities of gaining substantial relief through inaugurating or increasing bus-voltage compensation at generating and major supply stations. This can be most effectively accomplished by exploring voltage conditions and versatility of voltage-control facilities available throughout the system. Some of the steps are familiar. Not all are advocated for each and every case:

1. Become definitely inquisitive and make a searching survey of factors determining voltage conditions.
2. Take the guide from the service and distribution-voltage needs, with the objective of optimum system-wide use of voltage control facilities.
3. Make it a system competently handled, with co-operative participation of distribution, transmission and generation groups.
4. Accumulate dependable and representative voltage and load data for the systems. This may require rearranging, augmenting and calibrating existing voltage-recording equipment.
5. Correlate these voltage and load data and study them with ingenuity for opportunities to save. In this, the device of plotted voltage profiles is useful—the network analyzer even might be justified.
6. Study performance of equipment to reappraise use limitations, both from overduty and underduty, including such as:

Excitation of generators.

Excitation and tap-range of transformers.

Utilization of tap-changing-under-load equipment.

Utilization of synchronous condensers for supplying both leading and lagging reactive power. This includes the pressing into duty of idle generators as synchronous condensers.

* Adapted from recent papers by A. E. Silver, consulting electrical engineer, Ebasco Services, Inc., New York, before Southeastern Electric Exchange and Edison Electric Institute.

Programs Release Capacity Margins

Location and utilization of voltage regulators in both boost and buck ranges, for maximum load capacity; or reconnection, relocation or removal of those causing current-capacity bottlenecks.

Location and control of shunt reactors.

Location and control of shunt capacitors.

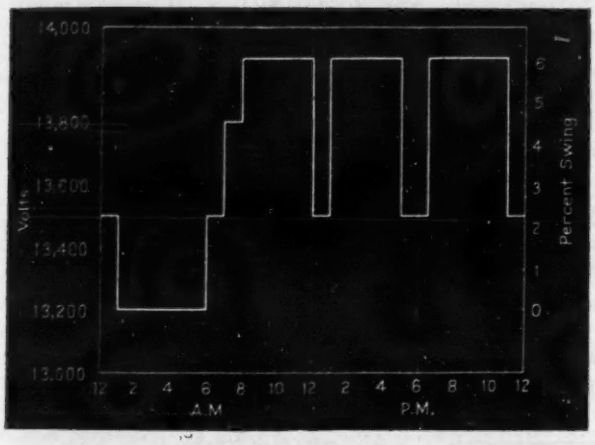
Internal-system and interconnection limitations on system stability.

7. Manufacturers' advice in normal times may have influenced quite conservative practices in equipment operation, including generator or transformer excitation. Reconsider these factors with them, for the manufacturers are keenly alive to the emergency needs and actively studying ways for taking best advantage of equipment characteristics and for safely operating equipment with closer margins.

8. Scheme out strategic adjustments for more effective use of available margins found under (6), in dealing with voltage levels of specific areas or circuits in distress.

9. Provide voltage co-ordination with interconnected neighboring systems by securing co-operation of respective operating engineers and load dispatchers.

10. Develop compensated bus-voltage operating schedules for generating stations and for transmission supply stations, advising with load dispatchers and generating-station and substation operators. In some cases bus voltage may be swung as much as 10 percent and even more.



TYPICAL voltage schedule for four-company interconnection

11. Apply corrective measures on a trial basis progressively as findings develop from investigational study. If a measure has promise, try it out, rather than prolonging debate on its feasibility. An occasional unsuccessful experiment is more than justified by the things that unexpectedly work.

12. Sell the ideas, reasons and benefits to all who will be party to successful carrying on, from time to time, as revised operating practices are evolved.

13. Encourage all persons participating to offer suggestions, and give each one of these careful consideration. Continue concentrated responsibility in competent hands.

14. Keep up the quest. Continue alert to finding ways for realizing increased versatility and use factor from each item of control equipment in dealing with each successive voltage bottleneck.

Extent of applicability of the foregoing list depends on status of accomplishment in an existing situation and on the war-emergency necessity for short cutting.

Four-Company Example

One example from actual experience of an Ebasco client system is a situation embracing four systems operating interconnected, namely, those of Arkansas Power & Light Company, Louisiana Power & Light Company, Mississippi Power & Light Company and New Orleans Public Service, Inc. In 1940 loads were building up in certain areas to cause inadequate service voltages. The four companies joined in a thorough survey and analysis of existing conditions and of possibilities of better co-ordinated voltage control for the entire interconnected situation. Upon request, an experienced engineer of the Ebasco staff was assigned to aid in organizing, carrying forward and co-ordinating this work.

It was found necessary, as the first step, to reorganize and extend the means for making records of voltages and loads at various key stations throughout the networks. Thereupon was undertaken a thoughtful study of points of stress, both from low voltage and from high voltage, with an increasing understanding of limiting factors. Close attention was given to:

1. Over-all co-ordination of transformer ratios by tap adjustments.

2. Bringing voltage levels high enough so that in the load valleys synchronous condensers and regulators would operate in the buck range.

3. Switching on and off of shunt reactors existent at certain stations.

4. Working out co-ordinated schedules of swings for generating-station bus voltages.

5. Working closely with generating-station and substation operators to try out changes in operating schedules.

6. Watching results in voltage improvements at the distribution extremities, as well as difficulties occasioned at any points on the system.

An early result of this survey was to emphasize the fact that a large customer located near to a key generating station was establishing a ceiling on generating-station voltage and depressing voltage levels in many of the distribution system extremities. It became evident that no more was required than a small regulator to give this critical customer a satisfactory lighting-service voltage to allow carrying generating-station voltage considerably higher at peak loads and thereby immediately lift critical service-voltage levels in wide distribution areas, also make synchronous condensers available for bucking down these distribution-area voltages during light-load periods.

Voltage Schedule

These studies were coupled with trials of various departures in operating practices. By increasing steps, compensating voltage schedules for key generating stations were put into regular operation. A typical week-day schedule is given:

13,200 volts	1:00 a.m. to 6:00 a.m.
13,500 volts	6:00 a.m. to 7:00 a.m.
13,800 volts	7:00 a.m. to 8:00 a.m.
14,000 volts	8:00 a.m. to 12:00 noon
13,500 volts	12:00 noon to 1:00 p.m.
14,000 volts	1:00 p.m. to 5:00 p.m.
13,500 volts	5:00 p.m. to 6:30 p.m.
14,000 volts	6:30 p.m. to 11:00 p.m.
13,500 volts	11:00 p.m. to 1:00 a.m.

This shows a swing at peak to more than 6 percent above the bottom voltage held in the valley period. In the Sunday schedule this swing dropped to approximately 2%. Possibly even greater variations are advisable.

Many other factors came in for study and recommendation, such as shifting location of certain regulators and reactors to gain maximum usefulness, determining locations of maxi-

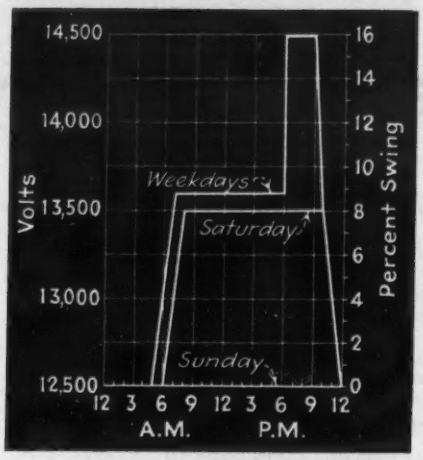
mum usefulness and schedules for switching on and off of several shunt reactors on the system.

The important thing emphasized by this survey is the fact that a systematic, concentrated study did largely extend compensated-voltage control at generating stations and bring out other opportunities, for sufficient improvements in voltages in the distribution extremities, to take on considerable added loads without substantial expenditures for new condensers, feeder regulators, capacitors, etc.

Also, this situation evidences the practicability of co-ordinating compensated generating-station voltage control as among neighboring systems. It is usually found that system-voltage control has much in common as between systems, and that when worked out, respective system voltages may be raised and lowered together, with mutual benefits.

Second Example

Carolina Power & Light Company's system covers a large, thinly populated territory served by an extensive 110-kv. transmission system. Due to the high ratio of transmission-line charging kvar. to system off-peak load, it is necessary to use the off-peak period as a base for establishing voltage levels for all periods. This is accomplished by adjusting transformer taps at generating plants, synchronous-condenser stations and primary substations for the highest practicable service-voltage levels during off-peak hours when minimum excitation is maintained on synchronous condensers and unity power factor on generators. Excitation of the generators and synchronous condensers of the system is then increased by the plant operators in accordance with voltage schedules arranged to fit the load envelope of the system. These schedules are under the supervision of the load dispatcher and are changed slightly from day to day, whereas major changes follow a seasonal variation.



MAJOR hydro station of Carolina Power & Light operated at three voltage levels for varying week and week-end loadings

Under this method of voltage control full excitation of synchronous machines is approached only during on-peak hours of dark days. Present operating criteria specify unity power factor as minimum excitation for generators; however, the advisability of lowering this value due to increased stability derived from high-speed excitation and high-speed relaying is now under consideration. Maximum excitation is governed by armature temperature and field current (lacking field thermometers) as well as corona effects. For generators with corona-proof windings, armature temperature and field-current limits only are observed.

In the past certain 110-kv. transmission circuits were taken out of service during off-peak hours in order to reduce charging kva., but this practice has been disconnected on account of increased off-peak loads and to avoid jeopardizing service to customers. Typical winter schedules for voltage at a generating plant and a synchronous-condenser station are given in the accompanying table.

During past emergencies the voltage at the generating station scheduled above has been carried as high as 15,000 volts, or 20 percent above the light-load base voltage. At the present time daily voltage profile curves are in the process of inauguration, to be compiled by the dispatcher, one curve to be at the time of maximum system load and the other curve to be at the time of minimum system load. Actual 110,000-volt readings will be used and will be taken from key points on the system. It is hoped that such voltage profile curves will assist in maintaining satisfactory system voltage, also reveal other useful information.

Urban

A third example is a system comprising moderate transmission distances and an extensive urban area, where war demands rapidly brought about overload to a degree that extensive reconstruction appeared imminent. A survey showed 54 4-kv. feeders serving these overloaded areas, each equipped with feeder regulator, performing the function of boosting voltage not exceeding 10 percent, but constituting a bottleneck to the amount of load that could be handled. It was determined that by scheduling generating-bus voltage for approximately 10 percent variation between high and low load these regulators could be cut out, the 4-kv. circuits more heavily loaded and service voltages still kept at acceptable levels.

All interested personnel were then called together and the picture and proposal presented. A period was given to think the matter through carefully, with a request to bring all reasonable objections to a later meeting.

A few objections were offered, such as voltage spread on plant auxiliaries, reactive-power interchange between stations, low voltage on industrials at night. These matters were tested out by trial voltage schedules, with instruments and observers. No substantial troubles developed and it was agreed to put the procedure in effect on a permanent basis.

Typical Winter Schedules for Voltage
Major Hydro-Electric Station

Day	Period	Generator Voltage	Approximate Kvar Reactive
Sunday	Midnight to midnight	12,500	0
Monday	Midnight to 5 a.m.	12,500	0
Tuesday	5 a.m. to 7 a.m.	12,500–13,600	0–30,000
Wednesday	7 a.m. to 6 p.m.	13,600	30,000
Thursday	6 p.m. to 9 p.m.	14,500	46,000
Friday	9 p.m. to 10 p.m.	14,500–13,500	46,000–30,000
	10 p.m. to midnight	13,500–12,500	30,000–0
Saturday	Midnight to 6 a.m.	12,500	0
	6 a.m. to 8 a.m.	12,500–13,500	0–20,000
	8 a.m. to 10 p.m.	13,500	20,000
	10 p.m. to midnight	13,500–12,500	20,000–0

The foregoing swing is 16 percent above the base voltage at the bottom of the valley (see chart).

PRIORITIES PROBLEMS

U-1-f Interpretations

1 **Is it the intent of U-1-f to limit extensions to commercial and industrial consumers to those localities listed in Schedule A?**

Definitely not. Under paragraph (b) (2), Schedule A applies only to extensions to domestic consumers.

2 **May an extension to a farm residence or tenant house be classed an extension to a domestic consumer? If so, may materials be used, within limitations of U-1-f, in addition to those required by an extension authorized under supplementary order U-1-c?**

Farm residences and tenant houses may be classified as domestic consumers if they are used exclusively for dwelling purposes. Despite the fact that an extension under U-1-c may have been authorized for a given farm, material may be used for an extension of service to a domestic consumer on that same farm under U-1-f when the dwelling is in a locality listed in Schedule A.

3 **May an extension be built to serve a gas refrigerator or water heater under U-1-f if the extension will not also serve a cooking stove?**

Yes. U-1-f puts no restriction on the use to which an otherwise legitimate domestic extension may be put. Previously, OWU did not consider essential, and therefore refused to authorize, the installation of gas in a home already served by electricity, or vice versa, where the existing utility service would suffice for the proposed addition. Today, with numerous appliances unavailable, this policy has been relaxed.

4 **Is it permissible to build to the property of a domestic consumer an extension which lies both within and without a designated area (Schedule A), provided the dwelling itself is located within the designated area?**

Yes. The location of the dwelling determines whether an extension to domestic consumer may be erected under U-1-f.

5 **Was it intentional that reference to institutions covered by Controlled Materials Regulation 5A (schools, churches, etc.) was omitted from paragraph (b) (3) (ii)?**

Yes. Such institutions will continue to be handled by specific application on Form WPB-2774.

6 **Would the extension of a third wire be an enlargement of service already installed and thus banned under the provisions of paragraph (b) (5)?**

Yes, such an extension is banned under U-1-f. However, under paragraph (h) (1) (iii) of Order U-1, a utility may enlarge a transformer bank or the size of conductor when it becomes necessary to do so to provide service at minimum service standards, and when the net cost is within the $500 and $1,500 limitation.

7 **Schedule A provides that extensions to serve domestic consumers who live in a locality not designated a metropolitan area may be made anywhere within the city or corporate limits of the locality and at a distance not to exceed 10 miles in a straight line from such limits. Does the 10-mile allowance apply to extensions outside metropolitan areas as well?**

No. The allowance is limited to areas not designated metropolitan areas. In the case of the two counties listed in Schedule A, St. Mary's County, Md., adjoining Baltimore, and Beaver County, Pa., adjoining Pittsburgh, and in such others as may be added to Schedule A, the 10-mile allowance does not apply. Domestic extensions in these counties must be confined to the county limits.

8 **When an extension can be erected with the use of secondary conductor only, is it required that such conductor come from excess stocks of a utility?**

No. Under paragraph A II of Schedule B, domestic extensions are the only extensions on which restrictions as to secondary material have been placed. These restrictions deal only with the conductivity of the conductor and do not affect the source of supply.

9 **May lead-covered cable be used for secondary extensions?**

Yes, within the conductivity limits established by paragraph A II of Schedule B, affecting domestic extensions.

10 **Are ground wires and taps included in the 900 allowable conductor-feet of primary line for domestic and commercial extensions?**

No.

11 **Do Schedule B's limitations on the allowable quantity of materials include any materials used by or for the consumer for that part of an extension built by or for a consumer?**

Yes. The same philosophy applies here as applies in paragraph (b) (3) (i), under which the dollar limitations on extensions include the cost of any facilities built by or for the consumer. As in Order U-1, the $500 and $1,500 construction cost limits apply solely to cost of materials.

12 **May lead-covered cable be used for extensions to qualified industrial consumers?**

Yes.

13 **Are materials used under U-1-f subject to the control of U-1?**

Yes.

14 **Do the Utilities Construction Standards on the types of specified conductor apply to extensions serving industrial consumers?**

No. It is not the intention of the order to restrict materials available for industrial extensions to limits as rigid as those for commercial and domestic extensions.

15 **Is it permissible to use copper salvaged from plant for primary lines?**

No. Under paragraph A I (b) of Schedule B, conductor consisting exclusively of copper is barred for use as primary line.

16 **The administrative letter accompanying U-1-f listed three points with which appeals for permission to exceed the restrictions of U-1-f on domestic extensions must comply. Are there any standards for appeals on commercial and industrial extensions?**

There are no standards for appeals from U-1-f regarding commercial and industrial extensions. The standards covering appeals for domestic extensions, however, must be rigidly adhered to.

OWU will not consider such appeals which do not state that the standards have been met. Utilities should not merely say that a case they are appealing meets the three appeal standards. They should cover each standard specifically, stating, for instance, that the home is to be occupied by John Blank, who is employed at the Blank Products Co., maker of industrial pumps (Schedule I, CMP Reg. 5), that the dwelling is within 10 miles in a straight line of the Blank Products Company plant in which Blank is employed, that the extension will help relieve a local housing shortage and that all of the Utilities Construction Standards have been met.

Such appeals, which are to be made on Form WPB-2774, must be marked plainly "Appeal from U-1-f."

Editorials

S. B. WILLIAMS, *Editor*

Advertising Program Gaining Support

IN THE two months that the utilities have been on the air in the extension of the co-operative advertising program the list of contributing companies has grown by more than 10 percent to a total of 151. Included among the newcomers are several sizable companies and it is understood that a number of other large systems are becoming very much interested.

Not only is this a tribute to those who are operating the program but it is a splendid demonstration that the electric utility industry can work together on a common problem. In December, 1941, when the advertising program started, there were but 52 contributors. To have grown threefold in less than two years is most encouraging to those who have hoped for solidarity in the industry.

With this experience it should not be difficult to take the next step of a unified program of education of the public, the employees and the lawmakers. It is already apparent what can be accomplished by telling the industry's story to the public. This can be greatly intensified by a unified program embracing employees and legislators as well.

Conservation Program Off to a Good Start

EVERY MAIL since September 15 is bringing us evidences of utility participation in the conservation program. The copy of the advertising varies naturally, but it is all constructive and indicative of wholehearted support. If there is any lip service we haven't seen it.

In this announcement stage, where the messages are for the most part explanatory, it is interesting to see the number of instances of co-operative advertising by all the affected groups, power, gas, water, telephone and transportation utilities. Such co-operation would seem to lend more strength to the movement than would be possible by individual statements.

This initial stage will probably be the easiest, for after telling the people the reasons for conservation, in spite of the fact that there is no power shortage, there comes the period of tactful persuasion and the constant selling of an idea that is contrary to all of our past practices. The merchants in many places will need a lot of patient convincing that conservation of electricity is necessary, especially when some competitors are obdurate. That, however, was understood when the voluntary plan replaced the mandatory brown-out.

The great advantage of the voluntary procedure is that it gives the companies the opportunity to build good will through the creation of a public consciousness of the utility all-out-for-victory policy. It gives the companies a perfect vehicle for telling about their services which have come to be accepted as a matter of fact and therefore not appreciated. It also gives the companies a natural for talking about bigger post-war use of things the customer is now asked to conserve.

Clarification of Federal and State Jurisdiction

CONGRESS will have the opportunity soon to clarify its intent regarding regulatory jurisdiction in the Federal Power Act of 1935. At the time of its passage it was widely understood that the bill was to make no encroachments on state regulatory powers, confining Federal Power Commission jurisdiction to such wholesale interstate transactions as could not be regulated by the states. Little by little, however, FPC has appropriated more and more authority, until in the Jersey Central Power & Light case, in which it was upheld by the Supreme Court, it invaded the state jurisdiction to the point where it was virtually impossible for any utility that is part of an interconnected system, regardless of the intrastate character of its business, to escape FPC regulation.

It has long been predicted in these columns that the states would contest this invasion of jurisdiction, and since no relief is to be had in the courts the bill must be referred back to Congress for clarifying amendments. At the recent Chicago war conference of the National Association of Railroad and Utilities Commissioners it was voted nearly two to one to present to Congress amendments that would more closely define FPC jurisdiction. Under the proposed amendments FPC would be limited to the regulation of wholesale energy sold in interstate trade for more than it cost to produce. Such definition would deny to FPC any regulation over interchange in which variations are settled for on the basis of cost. It would remove the load swing operation of interconnection as well as temporary emergency service from federal regulation.

The minority at the NARUC meeting expressed them-

selves as believing that such legislation if adopted would leave a considerable area of interstate operation without regulation. It seems difficult to see how this could be, because the transactions which would be removed from FPC authority are (1) sales at cost, (2) load swing slop-overs and (3) temporary emergency energy. All of these matters, to the extent that it is necessary, can be regulated by the state bodies.

But that is not the real issue, for there is no twilight zone of regulation that could be a major problem. The crux of the matter is that by limiting FPC jurisdiction to truly interstate commerce the federal agency cannot interfere in such matters as accounting, rates and financing, which the states are fully competent to regulate without any outside interference.

It must be recognized that there is a need for both federal and state utility regulation and the two should be complementary, not conflicting. However, the Federal Power Commission, like so many federal agencies, especially under the present Administration, has constantly been encroaching on states' rights, and until brought up by Congress will probably continue to claim increasing authority.

In some ways this may be considered a test of Congressional sentiment, not only with respect to interference with states' rights, but to the curbing generally of federal agencies that have overstepped their enacting legislation. We trust that a clear-cut decision is made by Congress and made soon.

Regulation of Co-ops Serving Non-Member Customers

IS A RURAL CO-OP a public or a private institution and does the fact that it is financed by the federal government give it any special privileges with respect to the laws governing other citizens and business operations in the area served?

So long as the co-ops operated within the letter and spirit of the Rural Electrification Act there was little reason why they should be subjected to commission regulation except in so far as public safety, welfare and convenience were concerned. Surely if they wanted to overcharge themselves, or give themselves poor service, that would be their own business. REA might interfere if operating practices were such as to jeopardize the government's loan, but otherwise the co-ops when serving their own members only had reason to believe that they should to a large degree be regulation-proof.

When, however, they enter the business of serving other than members for the purpose of making a profit, whether it be by taking on individual commercial or industrial loads or by serving whole communities through the acquisition of private utility property, they are no longer co-ops, but power companies in which the members are virtually the stockholders. Immediately any special status they had is changed and thereupon they are subject to the regulatory laws of the state the same as any other utility, not only with respect to the non-member customers but to all who receive service.

The matter is now up in Colorado, where a co-op that wants to purchase a utility property denies to the state commission any authority over its operations. The commission has taken a very common-sense stand, but the co-op claims special privilege as a federal agency. Sooner or later this issue must be decided in the courts, and if this Colorado co-op continues to be as unyielding as reported, this may be the case which will give legal definition to co-op status.

Reinspection for Post-War Re-employment

DURING the depression, when jobs were scarce, reinspection of wiring installations was urged as a means of providing employment. A survey made thirteen years ago by *Electrical Contracting* disclosed that in six out of every ten buildings there was defective wiring that needed replacement and that the average job should cost around $60.

No great progress was made, although it was demonstrated in a few places that reinspection was very productive of work. Its most serious drawback at the time, in spite of the fact that fully half of the city ordinances called for reinspection, was the very thing that it might have helped—unemployment. Courts were exceptionally lenient with the people and politicians were disinclined to add any further to the public's load.

A far different situation should prevail, however, after the war. People will then have money, while the necessity for employing returned soldiers and others will be so great as to make reinspection a national asset.

The wiring conditions that were disclosed in 1930 have not been improved. It would not be surprising to find a larger number of buildings with defective wiring and an average job at least 25 percent greater, if for no other reason than increased costs.

If at the same time the defective conditions are being corrected the owners could be persuaded to prevent their recurrence by providing adequate wiring the employment of wiremen would be further increased and the opportunity to sell more current-consuming devices would be expanded.

To the new post-war planning committee of the International Association of Electrical Inspectors we recommend a study of reinspection. Their findings should prove interesting to organized labor and to the entire electrical industry. It is doubtful if there ever will be another time when all the factors will be as advantageous for doing the job on a nation-wide scale.

Washington Comment

By R. N. LARKIN, Washington Correspondent

Utility Fuel Supply for Winter Assured

RESTRICTIONS clamped on the delivery of coal, both for industrial and domestic use, as well as the abandonment of the oil-to-coal conversion program, have provoked speculation over the possibility of an actual coal shortage this winter.

Neither the Solid Fuels Administration for War nor the bituminous operators are ready to admit that there will be a shortage of bituminous coal. Both parties are plugging strict conservation and both agree that the situation will be tight.

Rejects Priorities

One indication of Solid Fuels' belief that there will be no actual shortage lies in its rejection of all proposals that priorities be established for coal. The only such priorities which exist today are for high-grade metallurgical coals and for shipments to Great Lakes docks (ELECTRICAL WORLD, September 4 and 18, 1943, pages 87 and 82). The former is based on the steel industry's need for special coals, the latter on the fact that coal to be shipped on the lakes must be available before the fall freeze.

Solid Fuels justifies this position with the statement that the situation is not yet sufficiently serious to warrant more extensive priorities. The existing plan was suggested by the coal operators as capable of meeting the needs. WPB had argued for a priorities system, based on its traditional practice of distributing scarce commodities or materials on the basis of the user's essentiality, but Solid Fuels chose to go along with the operators. Thus far, it argues, the plan has worked excellently. When it fails priorities can be invoked. Meantime, Solid Fuels recognizes the special character of the electric industry's needs and it guarantees that utilities which must have coal will get it.

This does not mean that a utility in a rail shipment area will be allowed to stockpile coal unless its supplies are below what Solid Fuels considers the danger point for the area. Instead, Solid Fuels is pulling down stockpiles of utilities in these areas. The preference for coal going to lakes docks will be discontinued November 15, when stockpiling is about complete.

There is as yet no inclination on the part of Solid Fuels to commandeer coal from stocks of those users who have large supplies and allocate it to less fortunate users. In some cases where users in rail shipment areas have supplies for four to six months, all shipments have been stopped, and under Amendment No. 1, to SF Regulation 4, utilities buying in district 8 which have 60 days' supply or more are limited to 75 percent of their monthly burn. But as long as the situation is not sufficiently serious to require strict allocations on a priority basis, there is no need to take coal away from those who have unusually large stockpiles.

OWU Sets Up Liaison

Solid Fuels considers that the nation's critical inventory of bituminous coal in storage above ground for all uses lies between 40,000,000 and 50,000,000 tons. It admits that it doesn't know exactly where the critical point lies, but doubtless it would be affected measurably by the location of the available supply. If areas remote from the coal producing regions possessed a large percentage of the available stockpiles, the critical inventory conceivably would be lower than it would if the remote areas possessed only small amounts of the available stocks.

Meanwhile, the Office of War Utilities' fuel and allocations branch is attempting to become a focal point for utilities which need help in obtaining coal, and to this end has established liaison with Solid Fuels. E. F. Stevens, fuel superintendent of the Union Electric Co., of St. Louis, has been made chief of the Fuel and Transportation Section of the Fuel and Allocations Branch, with the duty of presenting to Solid Fuels the requests of utilities which need help. OWU suggests that companies seeking help exhaust all their own possibilities before applying, and that when they do come in, they be prepared to deal on a wartime basis.

While it guarantees to get fuel for any company which has to have it, Solid Fuels cannot promise to obtain it from those suppliers with which the utility normally deals. Nor will coal so obtained necessarily be of the customary grade or price. There may be shipping delays. In general, however, such help will entail only a minimum of extra cost, if any, for coal is under ceiling prices and Solid Fuels will make every effort to avoid higher freight charges than the utility seeking help is accustomed to pay. Higher freight charges mean longer hauls and less tons-per-car from a limited supply of rolling stock.

Inferior Grades

Where the coal which Solid Fuels furnishes a distressed utility is so inferior to that normally purchased that capacity will suffer, Solid Fuels will make available enough extra coal to maintain output. However, these problems normally will be kept to a minimum by the very nature of the Solid Fuels plan.

Requests for help are referred to the producers' board for the district in which the utility normally buys, the board wanting as little dislocation as possible in distribution.

In seeking special help, utilities are advised to apply to the Fuel and Allocations Branch through the WPB area power supply engineer. When Solid Fuels thereafter undertakes to provide the necessary coal, it attempts first to stop the drain on the company's stockpiles. Then, if subnormal deliveries have lowered these stockpiles to a dangerous level, it will make available sufficient fuel to rebuild them to a going level. Solid Fuels has not specified exactly what level is dangerous because of the obvious variables of locality, capacity, method of supply and the like.

NEWS OF THE WEEK

OWU Announces Major Amendments to Order U-1

Lower ratings for purchases of material for extensions to consumer premises provided — New allotment number required — Other changes aimed at avoiding confusion and simplifying provisions on inventories and service

Order U-1 has been amended by the Office of War Utilities to provide a lower rating for purchases of material for extensions to consumer premises. Numerous other changes, most of them technical, are made in the new U-1. There is some possibility that further revision of the order will be carried out by mid-October.

Change in Rating

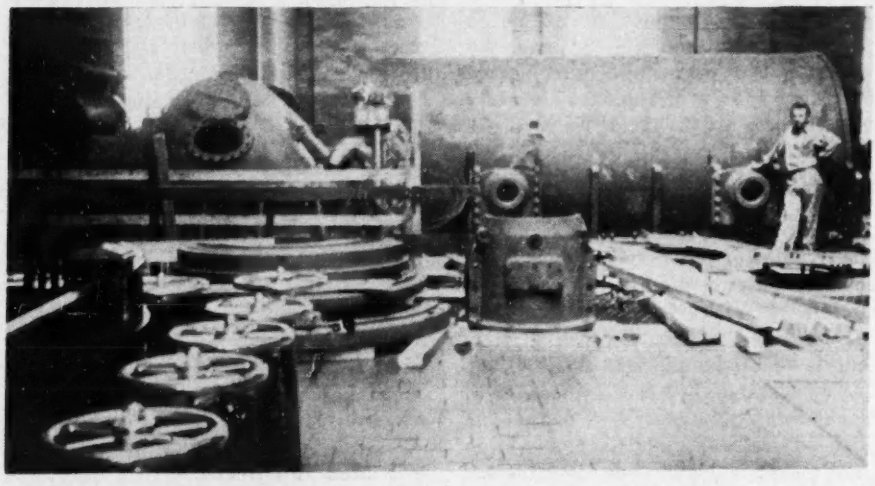
The AA-1 rating for purchases of MRO material is retained, but extensions to consumer premises which come under the $500 and $1,500 cost limits, and are therefore defined as "operating supplies," under paragraph (a) (7) (II), are no longer eligible for the automatic AA-1 rating. These extensions are now considered minor construction and material for them may be purchased only on an AA-3 rating. The move, which may increase the paper work required to conform to U-1, will put minor construction on the same preference rating basis as major construction, which, when approved on a special application, normally is given an AA-3 rating. This rating does not affect controlled materials, and the allotment number assigned for controlled materials for MRO use may be used for controlled material to be put into an extension to consumer premises.

Utilities will use a new allotment number under the new order. The new number, U-9, was substituted for the MRO-U symbol to clear up confusion which existed in metal mills, occasioned by the similarity of this and other claimant agency symbols.

Schedule E has been deleted and paragraph (c) (3) has been amended to refer to priorities regulation 3, in which are listed items for purchase of which preference ratings, or the blanket ratings assigned by U-1, may not be used.

Paragraph (d) (3), covering the special procedure for purchase of aluminum, has been stricken from the new order, and aluminum may now be purchased under the same procedure as other controlled materials.

Paragraphs (b) (2) and (e) (2), which have been superseded by supplementary orders U-1-d and U-1-f respectively, have been deleted. Paragraph (o) has been amended to make it clear that utilities covered by U-1 are not affected by the provisions of CMP regulation 5. Paragraph (f) (5) (II) has been simplified. Paragraph (a) (14) also has been restated to define a short item as any item, the stock of which on hand is insufficient to meet estimated requirements for the next 90 days. These items may be purchased in quantities which, on the date they are received, together with the estimated stock on hand as of the delivery date, will not exceed a 90-day supply. The restatement was occasioned by confusion in the industry which led numerous utilities to discount stocks of short items on hand when calculating 90 days' supply.



HUEY STATION UNIT—Final touches are progressing on the installation of the new 20,000-kw. turbo-generator at Arthur S. Huey Memorial Station of Oklahoma Gas & Electric Co. The new unit will give the station a capacity of 51,000 kw. and an estimated annual output of 350,000,000 kw.-hr., which will aid the entire system as the power is interconnected to all parts of the system and to the Southwest power pool

Estimated stocks on hand must be included in any 90-day supply calculations.

Other Changes

Paragraphs (a) (11), (f) (1), (f) (2) and (f) (3) have been simplified and clarified. A new paragraph (f) (4) (IX) has been inserted to establish a new ceiling value for practical working minimum inventory of electric meters. The move was made to adjust meter inventories to supply and requirements.

OWU also has amended Order U-1-f as follows:

Service to schools, churches and hospitals may now be extended if conditions of the order are met; that part of paragraph (b) (5) which prohibits enlargement of service has been deleted, and enlargement of service is permissible under other limits of U-1-f and several localities have been added to Schedule A. It is emphasized that the localities listed in Schedule A apply only to extensions to domestic consumers.

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WPB to Redistribute Idle Machinery

WPB has instituted a broad program —largely similar to that by which the Office of War Utilities redistributes the excess inventories of utilities—to redistribute used and idle machinery valued at more than $1,000,000,000 (CQ).

The program will be conducted by WPB's Redistribution Division, but will be operated principally on a regional basis. As in the OWU program and in similar redistribution programs previously installed to move frozen metal inventories, the sales will be made by owners to purchasers who have located needed equipment on regional inventory lists maintained at regional WPB offices. No fee will be charged for the service, but sales will be subject to OPA price ceilings. Sales of government property to dealers will be made on the usual bid basis. Sales of controlled products will be made only to purchasers certified as eligible by WPB.

Inventories are being compiled from reports of used-equipment dealers, voluntary listings by user-holders, War Department, Treasury's Procurement Division, Defense Plant Corp. and other government agencies. It is expected that 10,000,000 pieces, ranging from WPA sewing machines to industrial boilers and manufacturing equipment rendered idle by program changes, will be listed.

Power Equipment Gets New Scheduling Basis

Generating, substation, transmission and distribution equipment eligible for production under "frozen schedules" in new WPB order tightening schedules on components

WPB's Component Scheduling Plan, under which component items of critical end products are scheduled on the same rigid basis as the end products themselves, has been put on a mandatory basis by inclusion in Scheduling Order M-293.

Delivery Schedules Insured

Virtually all equipment used in a generating or substation and much transmission and distribution equipment is now eligible for production under "frozen schedules," which, when approved by WPB, are proof against interference by any other program, overriding directive, urgency preference rating or other device which in the past has dislocated delivery schedules to the immediate advantage of a "rush" program.

Power plants as programmed by the Office of War Utilities are included in the list of six vital programs eligible for the new "frozen" treatment of components. The list, generally considered to contain the most important programs now facing the nation's industrial capacity, includes ships as programmed by the Navy, Maritime Commission and War Department; advanced and overseas bases as programmed by the Navy; tanks, combat vehicles and transport vehicles as programmed by the War Department; power-generating stations; rubber plants as programmed by the Rubber Director, and high-octane gasoline plants as programmed by the Petroleum Administration.

Key components for these programs, many of which are already designated X or Y products for scheduling purposes under Order M-293, are now designated Z products as well, with the Z designation having reference to their production only when they are scheduled for one of the above programs. XZ products are scheduled and frozen in the same way X products are scheduled and frozen; YZ products in the same fashion that Y products are scheduled and frozen.

The order is expected to be of considerable value in preventing OWU's power program from slipping further behind schedule, inasmuch as components for the program, when frozen, will not be subject to delays caused by over-riding directives and other obstructions. Only WPB can alter a schedule when it has been frozen.

Those components scheduled by OWU which are for power plants will be frozen for delivery on the dates needed. Those scheduled by other WPB divisions will get the same treatment through OWU's construction coordinator, who will present the case for specific items to the scheduling agency and see that they are slated for delivery as close as possible to the date on which they will be needed in the construction of a given power project.

In the past conflicts between the power program and other rush programs pushed the power program behind (ELECTRICAL WORLD, September 18, 1943, page 78).

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Engineers Contracts To Sell El Paso

Engineers Public Service Co. has contracted to sell the common stock of the El Paso Electric Co. (Del.) to the city of El Paso, Texas, for $6,947,000, plus certain net current assets and adjustments to the date of closing, which may run close to $2,000,000, it was announced this week. The contract is subject to an election to be held in El Paso on October 9 to vote on the transaction, and to approval of Engineers board of directors. If necessary approvals are forthcoming, it is anticipated the contract will be closed on December 1.

The Securities and Exchange Commission issued a divestment order against Engineers Public Service on September 16, 1942, giving the company one year in which to dispose of the El Paso property. An appeal from the SEC order is pending with the Court of Appeals for the District of Columbia. Consolidated gross assets of the Delaware company, a holding concern owning all the common stock of El Paso Electric Co. of Texas, amounted to $19,460,000 on July 31, 1943.

Gross operating revenues were $5,014,743 for the twelve months ended on that date.

Penn Utility Men Look to the Future

Conferees at 36th annual meeting of Pennsylvania Electric Association look with confidence to post-war development of engineering, business development and other phases of utility operation

Confidence in the future of the utility industry characterized the sessions of the thirty-sixth annual meeting of the Pennsylvania Electric Association, held last week in Pittsburgh, with an attendance of close to five hundred. The principal speaker was Gov. Edward Martin of Pennsylvania, who told the convention that the government must not be allowed to become too powerful and overcentralized. "This growing centralization," said Governor Martin, "means more bureaus, agencies and commissions. It is giving us a government by men rather than a government by law."

Tribute was paid to the employees of the industry by Carl L. Peirce, Jr., president Hubbard & Co., by nominating them "to receive the All-America 'E' for a job well done for all America."

President E. H. Werner, after reviewing the administrative year, urged utilities to be mindful of the future. The requirements of peace will be great, he said, and progress should continue unabated.

Wheeler McMillen, editor-in-chief *Farm Journal*, stated that if the electrical industry is going to remain in private hands it will be only because all who believe in it take the trouble to make it work. "Private enterprise," he said, "can survive only by expansion. You must provide better service to more and more people at less cost."

Engineering Sessions

At the engineering meeting, under the chairmanship of H. S. Fitch, West Penn Power, the seven committee reports gave a panorama of technical practice as it exists today. E. C. Stone, Duquesne Light, presented engineering post-war planning from two angles—competition and co-ordination with business program. The construction program, he said, would have to be co-ordinated with the general business situation to be of greatest value to the community, thus when prices and employment are high limit construction, and vice versa. Competition can be helped by careful attention to wartime expansion, to possible standards of equipment, maintenance and customers' service cost. Mr. Stone looked forward to post-war period, he said, with considerable optimism.

How does the industry stand with the public and what shall be done about it generally and competitively was discussed in the business development meeting, under the chairmanship of G. A. Gardner, Duquesne Light. The public, according to Harold D. Read, Opinion Research Corp., is not antagonistic, it simply doesn't know or is misinformed. The better job that is done in rendering service, the more it is taken for granted. Good service has to be talked about to be appreciated.

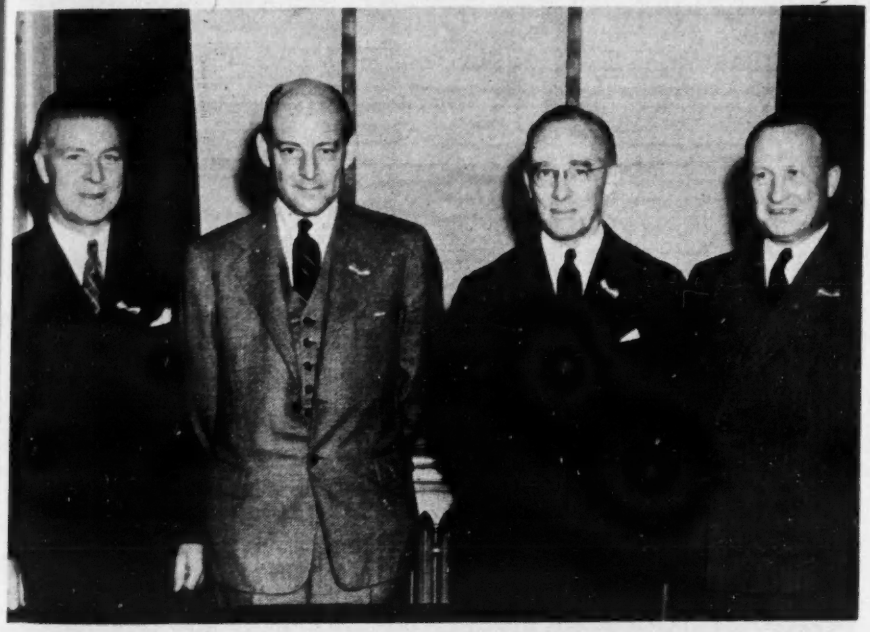
"Unless we do something to make the public conscious of the fact that they cannot get any better service anywhere," P. H. McCance, Duquesne Light, said, "we will be out of a job." He recommended improvement in job training, employee information and advertising.

Sees Greater Competition

It is reasonable to assume, J. F. Gaskill, Philadelphia Electric, stated, that competition in the future will be more and more exacting as others try to regain lost markets. In preparation, he said, utilities should know their own vulnerability, should acquire knowledge of applications and benefits to customers and be sure of the proper attitude of customers toward the company and its service. Now is the time to tell customers about the service. Also, it is essential that rates, rules and practices be scanned and that adequate contacts in the period before peace be maintained.

Safety award plaques were presented to Duquesne Light in the larger company group and Abbington Electric in the smaller.

P. H. McCance, Duquesne Light, was elected president, and G. E. Whitwell, Philadelphia Electric; Francis McQuillin, West Penn Power, and M. H. Parkinson, Pennsylvania Power & Light, vice-presidents.



NEW P.E.A. OFFICERS—Newly elected officers of the Pennsylvania Electric Association, which held its 36th annual convention in Pittsburgh, September 23, are shown above. Left to right, Francis McQuillin, West Penn Power Co., vice-president; George E. Whitwell, Philadelphia Electric Co., vice-president; Pressly H. McCance, Duquesne Light Co., president, and M. H. Parkinson, Pennsylvania Power & Light Co., vice-president

Correction

On page 83 of the September 18 issue, in a news story entitled "Southwest Power Shortage Asserted," Douglas G. Wright, acting administrator of the Southwestern Power Administration, was quoted, at a flood control conference at Fort Smith, Ark., as declaring that "the flood storage space of the dam (Pensacola) was only 9,000,000 acre-feet." This was a proofreader's error and should have read "920,000 acre-feet."

Southeastern Engineers Probe Utilities' Problems

How to continue doing a good job in wartime and coincidentally to prepare for greater responsibilities when peace comes occupy engineers at Birmingham meeting

Confidence and a disposition to look ahead to see what comes next were strikingly apparent at the fall conference of the engineering and operating section of the Southeastern Electric Exchange, September 23 and 25, at Birmingham, Ala. Confident that they can handle their wartime difficulties, having met and solved what they hope are the worst of them, these utility engineers are now taking time to think of what they will have to do in the post-war world. The program of the meeting fell naturally into three distinct divisions—present problems of operation; post-war considerations, and engineering concerns, *per se*.

Present Problems

In the first division were a notable group of papers and discussions. Charles T. Brasfield, Jr., Alabama Power, speaking on operating practices under wartime conditions and restrictions, pointed out that a closer integration of all operating departments is resulting from the present necessity for intimate co-operation. How long-unquestioned ideas are being changed and standards and specifications are being modified by enforced substitutions of materials and revisions of methods were clearly stated in an excellent presentation by C. B. McCartney, Florida Power Corp. That the proportion of women in utility employment is increasing rapidly and that women do not stick on the job very well were two facts brought out in the discussion of manpower utilization led by the chairman of the section, P. J. Carlin, Florida Power & Light.

Other subjects covered in the discussion were replacement schedules, deferments and the extended work week. High in interest in this division of the program was the talk by H. I. Miller, Office of War Utilities, on listing and exchange of materials, which was followed by a free-for-all of questions and answers on excess inventories, pricing of goods sold and conditions of excess shipments. Mr. Miller stated that the autonomy of OWU in the War Production Board set-up has helped the utilities greatly in the handling of inventories and purchases, and that total utility inventories decreased $21,000,000 in the second quarter of 1943—proof that the excess is being drawn down.

Post-War Considerations

Under post-war considerations came a glimpse of tomorrow in an exciting talk by R. C. Bergvall, Westinghouse, on the influence of new materials on future designs. Most immediate progress after the war, said Mr. Bergvall, will be in improvements of materials which will make old things better, rather than in production of radically new things. Utilities will be wise to set up records now of employment changes to serve as a firm basis for personnel readjustments when the war ends, said C. S. Thorn, Birmingham Electric.

C. B. McManus, Georgia Power, urged the setting up in detail of planned maintenance schedules to be followed as well as may be now and to be ready for instant application when peace comes. Methods of utilizing existing facilities to serve new sources of load with minimum system investment in view of load growth possibilities were discussed by F. C. Weiss, Alabama Power, and a look beyond V-day was taken by E. S. Fitz, Virginia Electric & Power, in a paper on long-range plans for system improvement, read in his absence by J. M. Barry.

Engineering Topics

The third division of the program covered a wide range of engineering subjects. M. C. Miller, Ebasco, presented the results of a study of the effects of reactive power on loading, on voltage drop and regulation and on investment throughout the electric system from generation to points of utilization. A scholarly paper on an exact method for determining capacities of grounding banks was offered by L. L. Stahler, Florida Power & Light. In his paper on application of heat exchangers on power transformers, C. H. McAllister, Tide Water Power Co., told of raising a 5,000-kva. bank to 8,400 kva. by this means. A lucid demonstration in miniature of how fuses, reclosers and the two together function to improve service continuity on rural lines was given by R. F. Quinn, General Electric.

Two interesting discussions featured the final session. One, led by V. R. Parrack, Virginia Public Service, covered the characteristics of various types of motors and their effect on utility facilities. Questions and comments from the floor proved that motor-starting flicker is still far from being a solved problem. Measures to prevent service interruptions from lightning was the second discussion subject, led by W. R. Doar, Carolina Power & Light.

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Excess Transformers Classified by OWU

A program to insure that distribution transformers sold from excess stocks of electric utilities are usable has been established by the inventory control branch of the Office of War Utilities.

Under the program, excess distribution transformers, defined as those having a secondary voltage capacity of less than 700 volts, or of less than 150 kva. capacity, are to be classified as new, first class or serviceable. Transformers in excess inventory which cannot meet the standards of one of these three classes are to be scrapped. Those transformers which do not meet one of the classifications, but which, in the opinion of the owner, should still not be scrapped, may be kept in inventory provided the transformers classified as new, first class or serviceable are first made available for sale in that order.

Utilities will not be required to purchase transformers from excess stocks unless they qualify at least as serviceable. When a prospective transformer purchaser is referred by a regional WPB engineer to a transformer and finds it unserviceable, he may obtain another reference. Third quarter inventory reports on Forms WPB-198 and UF-22 will require transformers to be listed in accordance with the program.

Standards have been established as follows:

New—Never in service.

First Class—Not requiring repairs of any kind and which has been in service not more than ten years and was manufactured after January 1, 1930, or has a steel tank and has had coils installed after January 1, 1930.

Serviceable — Leads rehabilitated; bushings inspected and replaced if necessary; case in good condition, with no mechanical damages and painted if necessary; oil in good condition; able to withstand an insulation test at 150 percent of rated voltage, and manufactured after January 1, 1925, or has had new coils installed after January 1, 1925, and has a steel case.

I.A.E.I. Group Analyzes Post-War Requirements

Eastern section, meeting at Providence, voices vigorous support of military needs — Future electrical material and installation practices display rapid growth in importance

Wartime problems presaging widespread changes in electrical service and facilities after the close of hostilities featured the annual meeting of the Eastern section, International Association of Electrical Inspectors, at Providence, R. I., September 20-22. Nearly 300 attended, the program of 65 items covering active topics in the field of fire prevention, trends in electrical equipment application, power-factor correction, fluorescent lighting and horizon views of electronics advances.

Post-War Committee

President Thomas Bowry of the International organization pointed out post-war responsibilities of the membership. Among these will be sales control, centralized inspection, treatment of uninspected work, wiring changes, education of the public along safety lines, civil service requirements, the status and future field for substitute materials developed under war conditions and the restoration of code authority where temporarily held in abeyance. A post-war association committee to deal with forthcoming problems was then appointed, consisting of G. Welman, New Orleans; V. H. Tousley, Chicago; M. F. Cody, New York; W. Cyr, San Francisco; W. A. Haig, Milwaukee; A. M. McLean, Portland, Ore.; V. C. Mounton, Denver; R. B. Shepard, New York (at present with WPB, Washington, D. C.); H. J. Stayner, Salt Lake City, and T. W. Bowry, Richmond, Va.

Secretary Tousley pointed out that electrical fires are increasing in proportion to totals in industry, being one in four, compared with one in five a year ago. Inspection must be increased as soon as possible, costs of such work being secondary in importance.

R. C. Graves, Trumbull Electric Manufacturing Co., discussed busway developments in industrial plants as influenced by recent WPB material restrictions. It is estimated that Order L-315 will save 100,000 lb. of copper, 3,400 tons of sheet steel and 450,000 lb. of zinc. Underwriters Laboratories has co-operated with WPB in issuing wartime emergency standards. The use of porcelain block insulators to support bare busbars of the plug-in type and of continuous fire-resistant insulating sheaths on the feeder run type has eliminated the use of rubber, besides permitting higher temperature operation. For the duration the Underwriters Laboratories are allowing a temperature rise of 70 deg. C. on such sheathed busbars in place of the former 50 deg. Smaller copper cross-sections also reduce mutual inductance if conductors are spaced closer.

A warning note against encouraging substandard wiring even under war conditions was sounded by M. H. Hedges, research director I.B.E.W., who said that if inferior material is widely permitted to go into service many years will be required after the war to eliminate it. Rehabilitation of substandard installations to meet original code requirements is a forthcoming task. Every economic, social and engineering argument lies on the side of high standards of installation as protection against wartime fires and the loss of life. The speaker commended the work of the emergency standards committee as largely determined by WPB rulings, material shortages and wartime exigencies, but asserted that the electrical industry should resist any temptation to abolish the electrical committee (code-making body) in favor of a smaller, more agile group. He called attention to building opportunities estimated at $38,000,000,000 in the first three post-war years, with a housing market of one-third able to pay $3,000 to $5,000 per house and another third able to invest over $5,000 per house. From $120 to $300 should be budgeted in the future for house wiring as against $60 to $100 in the past.

Progress in the use of synthetic rubber insulation was reviewed by E. S. O'Connell, United States Rubber Co., and M. M. Brandon, Underwriters Laboratories.

Other Topics

Other topics included talks by O. K. Coleman, American Gas & Electric, on "Power Systems Interconnection"; "Power Problems in War Plants" (featuring benefits of capacitors), B. R. Payne, United Illuminating Co., New Haven; "Wartime Fire Protection," R. S. Moulton, National Fire Protection Association; "National Electrical Contractors' Association in Wartime," "Emil Preiss, "Accelerated Drying by Infrared Lamps," Paul Goodell, Trumbull Electric Manufacturing Co.; "Foreign and National Electrical Codes," H. E. Wey, U. S. Department of Commerce; "Cold-Cathode Lighting," C. M. Cutler, General Electric; "Experience in Supplying Machine Controls," R. P. Ballou, Colt Patent Fire Arms Mfg. Co.; "Make It Do for the Duration," H. R. Meyer, Westinghouse; "Post-War Housing," C. W. Farrier, National Housing Agency; "War Production and Safety," R. B. Shepard, Underwriters Laboratories; "Home Wiring Maintenance in War," Kemp B. Batchelor, National Adequate Wiring Bureau, and "Electronics Applications," F. W. Bliss, General Electric.

C. A. Ward, Paterson, N. J., was elected president of the Eastern section; G. S. Casterline, Syracuse, N. Y., and P. J. Hicks, Providence, vice-presidents.

I.A.E.I. OFFICERS—Left to right, C. A. Ward, Patterson, N. J., president-elect of Eastern section; T. W. Bowry, Richmond, Va., president, and F. N. M. Squires, New York City, secretary of the I.A.E.I.'s Eastern section

Contract Signed On Shasta Power

P.G. & E., Interior Department settle long dispute

Interior Secretary Harold L. Ickes has approved a contract between his Reclamation Bureau and the Pacific Gas & Electric Co. for the sale of 150,000 kw. of power to be generated at the bureau's Shasta Dam in north central California. The contract calls for a minimum annual payment of $2,775,000 beginning in 1945, but Interior officials expect annual charges to run in excess of $3,000,000 yearly when full Shasta capacity becomes available. President James B. Black signed the contract for P. G. & E.

Terms of Contract

Under the contract, Reclamation delivers the power at its Shasta substation, with P. G. & E. leasing the 72-mile transmission line from the Shasta substation to its own substation on Oroville, Cal., which it tried to build, but which Interior insisted on constructing. P. G. & E. will pay a $6,250 monthly rental fee for the line alone. The contract provides also that Reclamation may withdraw power committed to P. G. & E. at any time for sale to other customers, virtually all of whom in that area now buy from P. G. & E. The company is required also to attempt, by mutual agreements with Reclamation, to carry out the requirements of the Reclamation law which provides for preferential sale of publicly owned power to public agencies and co-operatives. Such establishments may apply for power immediately and need not wait until the war's end.

Until January 1, and while the Shasta reservoir is filling, P. G. & E. will take as much power as it can absorb. Thereafter, P. G. & E. will take 150,000 kw. of capacity, for which it will pay a demand charge of $125,000 monthly and a minimum of 800,000,000 kw.-hr. annually at the rate of 1.5 mills per kw.-hr. The contract will remain in effect until December 31, 1947, or until two years after hostilities end, whichever is later, but in no event beyond December 31, 1949.

Reclamation has the right to withdraw up to 50,000 kw. for any purpose, including sale to the municipal system at Sacramento, Calif. Whenever the bureau withdraws 25,000 kw. or more, it may repossess the Oroville transmission line, and thereafter it will deliver 125,000 kw. at Oroville. Under this arrangement, the demand charge would be $111,000 monthly and the energy charge 1.55 mills per kilowatt-hour. This would guarantee a minimum annual payment of $2,322,000.

Fuel Oil Substitution

P. G. & E. is required to substitute Shasta power for its own oil-fired steam power and for that steam-generated energy it buys from the Southern California Edison Co. as widely as possible. Energy rate for Shasta hydro power is estimated to be less than the fuel oil cost for steam energy. As Petroleum Administrator for War, Ickes has been forecasting a fuel oil shortage on the Pacific Coast for months.

Final approval of the contract came after almost two years of haggling and was achieved only after the House appropriations subcommittee on the Interior Department last March directed Interior to come to an agreement with P. G. & E. on a "wartime" contract for Shasta's energy. The same committee a year earlier had requested an early settlement of the matter, but no agreement was reached until now.

MEETINGS

19th Exposition of Chemical Industries—Madison Square Garden, New York, N. Y., December 6-11. C. F. Roth, manager, Exposition of Chemical Industries, Grand Central Palace, New York, N. Y.

National Association of Manufacturers—2nd War Congress of American Industry, Waldorf Astoria Hotel, New York, N. Y., December 8-10. J. M. Boyd, secretary, 14 W. 49th Street, New York, N. Y.

American Standards Association—Annual meeting, New York, N. Y., December 10. P. G. Agnew, secretary, 29 West 39th Street, New York, N. Y.

Previously Listed

National Safety Council — Congress and exposition, Sherman Hotel, Chicago, Ill., October 5-7. N. H. Dearborn, managing director, 20 N. Wacker Drive, Chicago, Ill.

Edison Electric Institute — Accident prevention committee, LaSalle Hotel, Chicago, Ill., October 8-9; prime movers, electrical equipment and transmission and distribution committees, Hotel Cleveland, Cleveland, Ohio, October 11-12. Col. H. S. Bennion, managing director, 420 Lexington Ave., New York, N. Y.

National Electrical Contractors Association — Drake Hotel, Chicago, Ill., October 10-11. L. W. Davis, general manager, 633 Investment Bldg., 15th and K Sts., N. W., Washington, D. C.

Kansas Association of Municipal Utilities—Annual convention, Civic Auditorium and Broadview Hotel, Emporia, Kansas, October 11-12. L. C. Angevine, secretary, City Hall, McPherson, Kansas.

Electrochemical Society — Fall meeting, Pennsylvania Hotel, New York, N. Y., October 13-16. Colin G. Fink, Secretary, Columbia University, 3000 Broadway, New York, N. Y.

Pennsylvania Electric Association — Electrical equipment committee, Benjamin Franklin Hotel, Philadelphia, Pa., October 14-15. A. N. Shealy, chairman, Pennsylvania Water & Power Co., Lexington Bldg., Baltimore, Md.

American Welding Society — Annual meeting, Hotel Morrison, Chicago, Ill., week of October 18. Miss M. M. Kelly, secretary, 29 West 39th St., New York, N. Y.

Engineers Council for Professional Development —Annual meeting, Engineering Societies Building, New York, N. Y., October 23. A. B. Parsons, secretary, 29 West 39th St., New York, N. Y.

National Electrical Manufacturers Association — Annual meeting, Waldorf Astoria Hotel, New York, N. Y., October 25-29. W. J. Donald, managing director, 155 E. 44th St., New York, N. Y.

Joint Fuels Conference — American Institute of Mining Engineers and American Society of Mechanical Engineers—Wm. Penn Hotel, Pittsburgh, Pa., October 28-29. T. E. Purcell, chairman, Duquesne Light Company, 435 Sixth Ave., Pittsburgh, Pa.

Pacific Coast Electrical Association — Wartime technical conferences, southern section, Los Angeles, Calif., October 28; northern section, San Francisco, Calif., November 4. Victor W. Hartley, managing director, 601 W. 5th St., Los Angeles, Calif.

American Society of Mechanical Engineers—Annual meeting, Pennsylvania Hotel, New York, N. Y., November 29-December 3. Ernest Hartford, executive assistant secretary, 29 West 39th St., New York, N. Y.

Appalachia Dam Begins Operating

Appalachia—TVA's newest dam and power plant—began generating power September 23 for the authority's transmission system, increasing the installed capacity of TVA's generating units to slightly more than 1,600,000 kw.

The Appalachia project, one of four TVA dams on the Hiwassee River system, authorized by Congress in July, 1941, to provide power for war purposes, is a departure from most TVA dams in that the dam is situated in North Carolina, some 12½ miles upstream from the power plant in Polk County, Tenn. Water is carried to the turbines through a 43,000-foot tunnel drilled through the hills, enabling Appalachia to develop a power head of approximately 360 feet, although the structure is only 150 feet high. Its construction and operation is similar to that of Ocoee No. 3 dam, placed in operation several months ago, but Ocoee's tunnel is only 2 miles long.

Appalachia is of concrete, 1,250 feet long and backs up water for about 10 miles to the foot of Hiwassee Dam, with a lake area of about 1,100 acres. The power plant will utilize the storage of Hiwassee River and Nottely River in North Carolina.

Sell Distribution System

R. A. Gallagher, president of the Indiana Public Service Co., Inc., has announced the sale of the company's distribution system in Lebanon, Ind., to the city. The sale ended six years of negotiation and court action. The original price voted by the citizens of Lebanon in 1937 was $150,000. This later was increased to $210,000, and ultimately to $352,000 by court action, the price the city finally paid. The city entered a ten-year contract with the company for the wholesale purchase of power.

Week's Output Holds High Level

The output curve showed signs of leveling off during the week ended September 25 with only a fractional gain over the figures posted the week previous. In previous years, however, a drop has occurred during the last two weeks of September and the present level indicates a more-than-seasonal gain. The amount of electrical energy distributed by the light and power industry for the latest week totaled 4,359,610,000 kw.-hr., compared to 4,358,612,000 kw.-hr. the previous week, the Edison Electric Institute reported. Figures for the latest week compare with 3,720,254,000 kw.-hr. for the corresponding week in 1942, a rise of 17.2 percent.

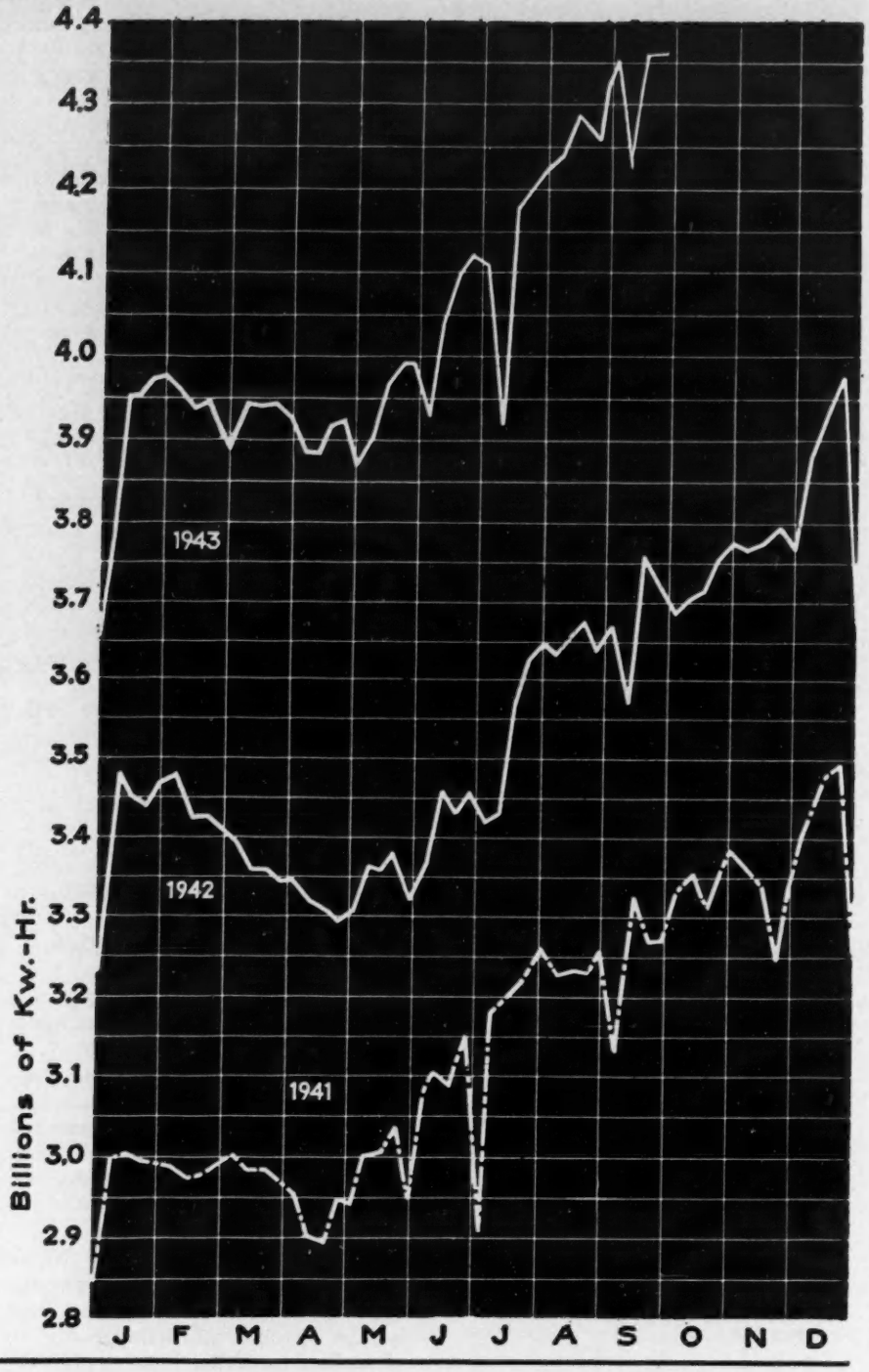
Five of the country's seven major geographic areas registered increases over the previous week in their percentage gains over 1942. One region, the Southern States, remained static at a 20 percent increase. In first place was the Pacific Coast, which increased its lead from 23.8 percent for the week ended September 18 to 26.5 percent for the week ended September 25. One region, the Rocky Mountain, fell off 3.9 percent for week of Sept. 25 as against the previous week.

Weekly Output, Million Kw.-Hr.

1943		1942		1941	
Sept. 25	4,360	Sept. 26	3,720	Sept. 27	3,273
Sept. 18	4,358	Sept. 19	3,757	Sept. 20	3,273
Sept. 11	4,229	Sept. 12	3,583	Sept. 13	3,322
Sept. 4	4,351	Sept. 5	3,673	Sept. 6	3,133
Aug. 28	4,322	Aug. 29	3,640	Aug. 30	3,261
Aug. 21	4,265	Aug. 22	3,674	Aug. 23	3,231
Aug. 14	4,288	Aug. 15	3,655	Aug. 16	3,238
Aug. 7	4,240	Aug. 8	3,637	Aug. 9	3,233
July 31	4,227	Aug. 1	3,649	Aug. 2	3,263
July 24	4,196	July 25	3,625	July 26	3,220

Percent Change from Previous Year

	Week Ending		
	Sept. 25	Sept. 18	Sept. 11
New England	+6.3	+4.7	+6.2
Mid-Atlantic	+18.4	+14.7	+19.1
Central Industrial	+13.9	+13.5	+15.1
West Central	+9.2	+9.0	+10.3
Southern States	+20.0	+20.0	+23.3
Rocky Mountain	+15.1	+19.0	+18.5
Pacific Coast	+26.5	+23.8	+22.4
Total United States	+17.2	+16.0	+18.0



Urges Big Missouri Flood-Control Plan

An ambitious plan to convert the Missouri River from a destructive to a productive stream, at a cost of hundreds of millions of dollars, has been outlined by Col. Lewis A. Pick, former division engineer, Missouri River Division, U. S. Engineers, and reported in *Engineering News-Record* for September 23.

"The cost would not be so great that it could not be paid for by the elimination of the damage done by the river," Colonel Pick says, in describing a complete flood-control system from the upper reaches of the Missouri to its mouth, a series of irrigation projects with power to operate them, and a nine-foot channel. Levees, nine or ten reservoirs and three or four dams are essentials of this over-all plan.

"The dams should be located in the upper reaches of the river," he said. "Possibly one could be in the Yellowstone just before it flows into the Missouri; another below Bismarck, N. D., and others above Pierre and Yankton, S. D. These dams would furnish water for irrigation and for power to pump the water where needed."

The colonel's plan will be in the hands of the Chief of Engineers, U. S. Army, shortly, the report said.

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Motor Repairmen Are Listed as Critical

Electric motor and equipment repairmen have been added to the list of critical skills in Washington, D. C., area by the area War Manpower Commission. The move followed a report by the Electric Institute of Washington that 4,000 unusable electric motors were standing idle in district repair shops for want of skilled repairmen.

Utilities Eligible for OCD Awards

To be based on "superior" plant protection

Electric utilities which have established "superior" plant protection services will be eligible for the new National Security Award established this week by the Office of Civilian Defense.

The award, open to all manufacturing, industrial and utility companies whose protection organizations pass rigid qualifications established by OCD, will consist of a certificate for the plant and individual cards or lapel insignia for members of the protectve organizations. Awards will be made to individual establishments and not on a company-wide basis in the case of companies with more than one plant. It will be withdrawn when standards fall below those established for the award. Size of the establishment will not be a factor in making the award.

Regional OCD directors are authorized to grant the award with the concurrence of the OCD Director and that of the appropriate State Defense Council. Companies which meet the standards may communicate with their local Defense Councils requesting consideration.

The award will be based on these general conditions:

(1) Establishment of superior security and protection measures in accordance with the requirements of the establishment. (2) Organization of sufficient protection personnel in accordance with recommendations of OCD. (3) Training and enrollment of protection personnel as members of the U. S. Citizens' Defense Corps. (4) Integration and co-ordination of protection and security measures with the local OCD organization. (5) Issuance of emergency instructions for all employees, establishment of proper air raid and emergency warning signals and designation of shelter areas. (6) General excellence in observing regulations and directives concerning blackout, dimout and other local defense requirements.

Utility Reports

	Net Income 1943	1942
*Central Maine Power	$3,387,691	$3,269,263
*Connecticut Light & Power	3,705,427	3,638,862
*Detroit Edison and subs	8,501,750	*9,307,909
†Electric Power & Light and subs	9,339,277	8,084,395
*Houston Ltg. & Power	3,229,170	2,454,980
†Iowa Elec. Light & Power	807,714	744,617
*Marion-Reserve Power	385,128	496,457
†National Power & Light and subs	6,360,947	4,857,649
†Pennsylvania Power	682,602	700,188
†Public Service Indiana	2,916,439	2,784,558
†SanDiego Gas & Electric	1,560,740	1,506,891
*Sioux City Gas & Elec.	726,160	431,322
†So. Carolina Power	555,958	481,984

*Twelve months ended August 31.
†Twelve months ended July 31.

Meanwhile, OCD furthered its plant security campaign with a program for coordination of post-raid restoration work of all utilities. Representatives of several utility industries met recently with OCD's Technical Board and agreed upon a directive to commanders of Citizens' Defense Corps recommending that they invite representatives of public and private utilities to form working groups for this purpose.

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128-Kv. Ohio Line Approved by OWU

Okay on other power program units expected soon

The Office of War Utilities has approved construction of a 128-kv. transmission line running 75 miles between Portsmouth and Trenton, Ohio, which will save power losses estimated at 20,000 kw. The line is part of the 1945 power program, four more units of which are expected to be approved shortly.

Approvals Anticipated

Expected approvals include the following:

1. No. 4 unit at Kentucky Dam, a 32,000-kw. hydro unit.

2. A 30,000-kw. steam unit for the Bainbridge plant of the New York State Electric & Gas Co. at Sidney, N. Y.

3. A 154-kv. transmission line running 125 miles between Nashville and the Watts Bar Dam of the Tennessee Valley Authority, which also will save 20,000 kw. in power losses. Both lines will be of aluminum.

An additional 100,000 kw. of steam capacity to be located in the North Central industrial area will be approved. Discussion as to which of three sites shall be chosen is still going on.

Installations of the 1945 power program thus far finally approved total 147,000 kw. Those on which approval is expected shortly total 182,000 kw. As many as 500,000 kw. may be installed under the program.

Meanwhile, the power division has approved installation of a 6,000-kw. hydro turbine and generator in the Dos Bocas plant of the Puerto Rico Water Resources Authority, operated by the Federal Works Administration. The generator is complete, the turbine about three-fourths done, with all necessary material on hand. The turbine will be completed immediately and the unit shipped to be in operation next summer, the power division said.

Retailers to Join Conservation Drive

C.E.O.C. has formula on lighting education

A recommendation that the central council of National Retail Associations urge its membership to "co-operate to the fullest extent practicable" in the government's conservation campaign was presented this week by the council's committee on service.

The council represents 18 retail associations, including such organizations as the National Automobile Dealers Association and the National Retail Furniture Association. The resolution called also for individual associations to act individually or jointly with local merchants and utilities in carrying out the Office of War Utilities program.

Meanwhile the Washington Board of Trade pledged its support of the drive at a meeting called by the Potomac Electric Power Co. after capital merchants almost unanimously disregarded the campaign during opening days as downtown streets were thronged nightly with visitors to Washington's "Back the Attack" war bond show.

President Tom P. Walker of the Council of Electric Operating Companies addressed the meeting, outlining the campaign's history and its reasons.

C.E.O.C. Lighting Formula

C.E.O.C., meanwhile, distributed to its members a formula for calculating possible reductions in white-way lighting, which, under the industry program, is to be reduced "wherever practicable." Citing recommended practice of the Illuminating Engineering Society, which suggests 1.2 lumens per square foot as an average amount of light for heavily traveled streets, C.E.O.C. estimated that on a street 60 feet from curb to curb the I.E.S. standards could be met by 12 watts per linear foot with luminaires equipped with refractors or directive devices, or by 20 watts per linear foot with luminaires using diffusing glassware but no directive devices.

As a safety measure, C.E.O.C. recommended the use of an additional 25 percent of this lighting in cities of 300,000 population or more and a 20 percent decrease from these standards in cities under 25,000 population, where local conditions will permit. The safety factor in large cities was to account for some of the illumination lost by dimming commercial lighting. The formula would be effective on streets from 52 to 72 feet, and proportionate increases or decreases would fit it for application to streets of greater or lesser dimensions, C.E.O.C. reported.

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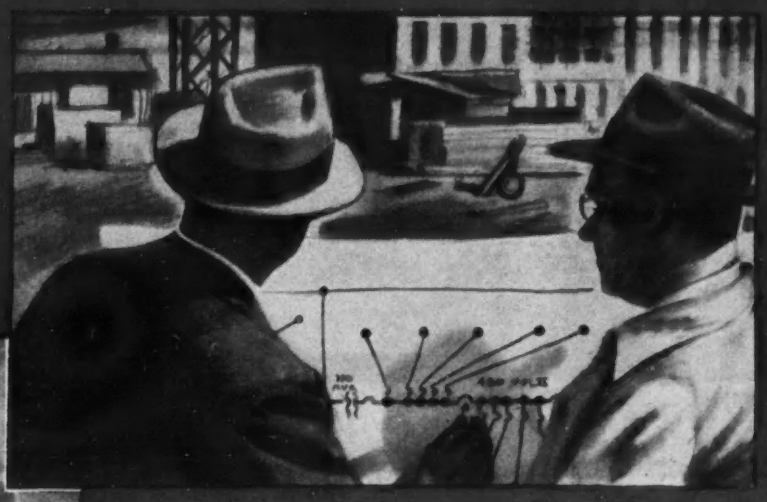
MEANS MORE SHELLS HERE



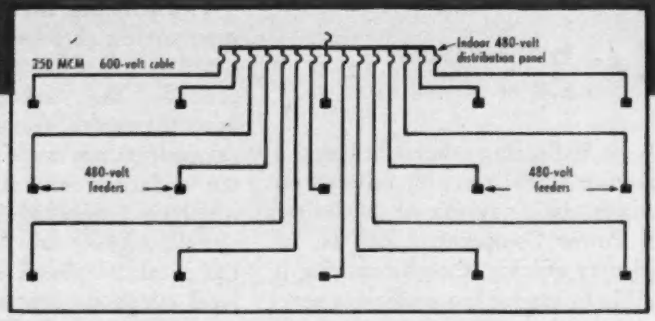
Load-center distribution makes that saving possible

Using load-center unit substations, you can install a complete, co-ordinated power system that requires far less copper and other vital material than you'd need for an old-style system with "piecemeal" substations.

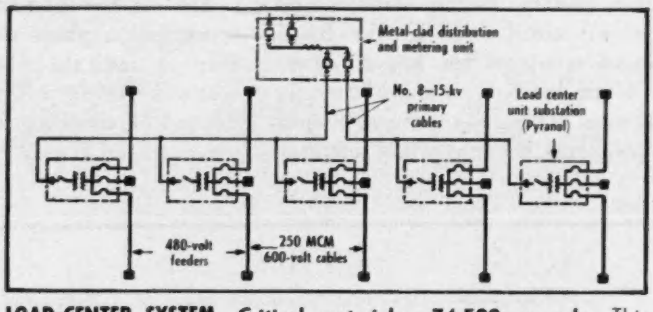
One recent installation saved 39,500 pounds of copper—enough to make 1,500,000 small shell casings. (At the right are diagrams of typical medium-size systems to show how this is possible.) On large installations, many times this amount can be saved.

Factory-built, safety-enclosed unit substations, which make load-center distribution possible, are designed for serving loads of 600 volts and below from incoming lines up to 13.2 kv. They are delivered ready to install right in the same room with the machinery to be supplied with power. You can add substation capacity *where* you need it, *when* you want it, largely eliminating the high cost of long, heavy, low-voltage circuits from a distant substation.

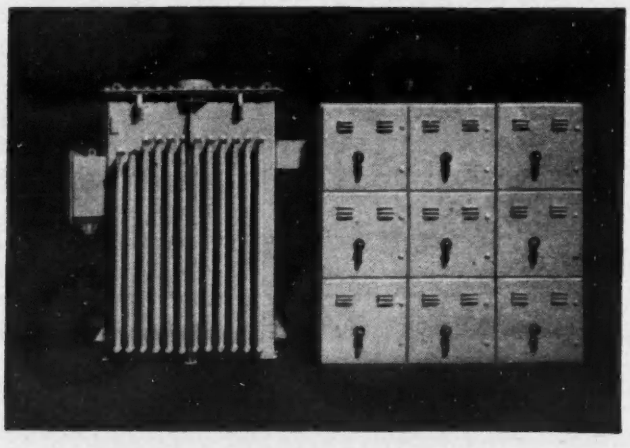
G-E unit substations, installed on the load-center plan, eliminate troublesome voltage drop, and improve the performance of your electric equipment. Load-center distribution is economical, both in its use of critical materials and in its over-all cost. It is the most reliable, flexible, and time-saving method yet devised for industrial power distribution. More information in our bulletin, No. GEA-3592. *General Electric Company, Schenectady, N. Y.*



OLD-STYLE SYSTEM. Critical materials—95,000 pounds. Note the long, heavy, secondary-cable runs to feed the fifteen load centers. And the capacity of this system can not be increased easily.


Metal-clad distribution and metering unit
No. 8—15-kv primary cables
Load center unit substation (Pyranol)
480-volt feeders
250 MCM 600-volt cables

LOAD-CENTER SYSTEM. Critical materials—74,500 pounds. This system requires 10 tons less critical materials than the one above, and saves more than 20 per cent of the cost. Capacity can be increased easily to handle new loads, or to meet shifting load conditions.



Load-center unit substations can be installed on overhead platforms, over washrooms, or between column centers, etc. to save space. Their infrequent need for inspection and maintenance saves you many valuable hours of maintenance time.

UNIT SUBSTATIONS

BUY WAR BONDS

GENERAL ELECTRIC

302-19-5900

HOW DESIGN... CONSTRUCT OPERATE MAINTAIN

Phantom Circuit Signals Outages

By L. E. PARKYN.
Superintendent of Transmission, Elkhorn, Wis.
Dairyland Power Co-operative, Genoa, Wis.

By an indicating scheme utilizing a "phantom signal circuit" failures on the transmission system of the Dairyland Power Co-operative can be located very quickly, thereby making it possible to render more efficient service to members taking service from the rural lines; outage time has been greatly reduced.

Line oil circuit breaker stations, branch feeders, fusing stations and step-down substations of the REA-financed co-operatives are of necessity often located on out-of-the-way rural sites. One of the largest operating problems, because of the scattered points, is to locate a line power failure with as little delay as possible.

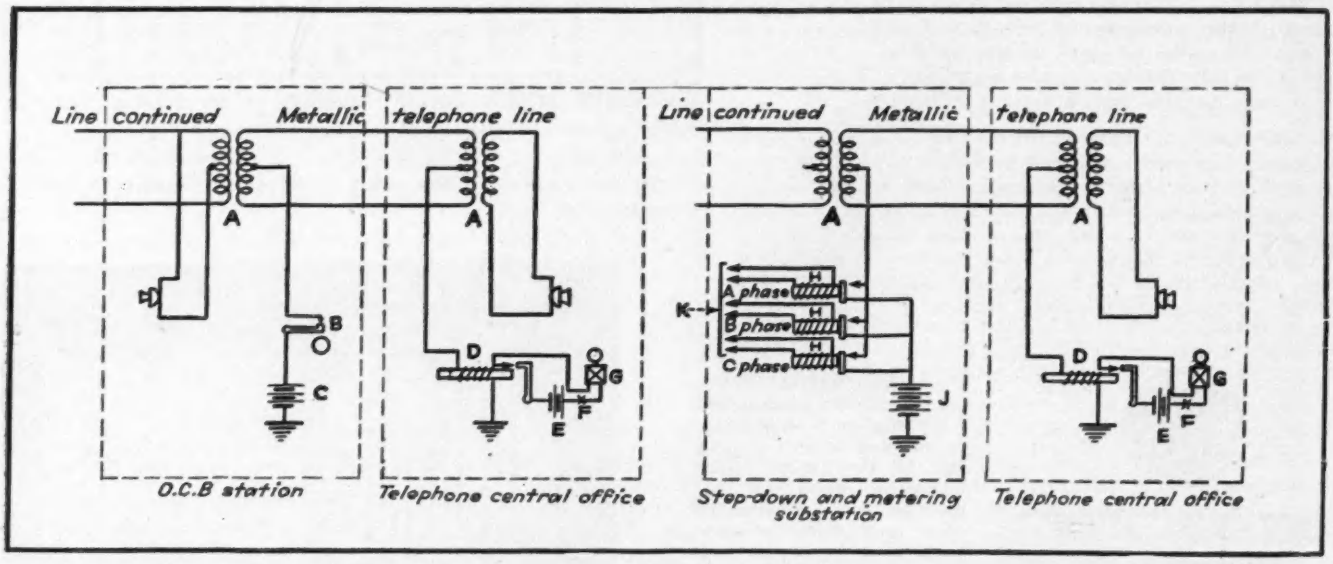
Two schemes, illustrated by the accompanying sketches, make use of a phantom telephone circuit. They depend for their successful operation upon the central telephone office. Arrangements are made so that the minute a failure occurs on equipment which is connected in the phantom circuit, signals are transmitted over the local telephone system and the local telephone central office is automatically notified. The operator immediately telephones the information to the line superintendent, who is enabled to give immediate service.

The scheme used to indicate power transmission phase outages is adaptable to indicate when a line fuse blows by using a small transformer instead of drawing the energy from the potential transformers.

Extra Register Dial Shows Hourly Flow

By adding a fifth register dial to Westinghouse type OA polyphase watt-hour meters installed at generating stations and substations metermen of the Empire District Electric Company, Joplin, Mo., have reduced the multiplier applied to meter readings one decimal point, thus making it possible to record small hour-to-hour interchanges of energy with neighboring systems, required for certain Federal Power Commission reports.

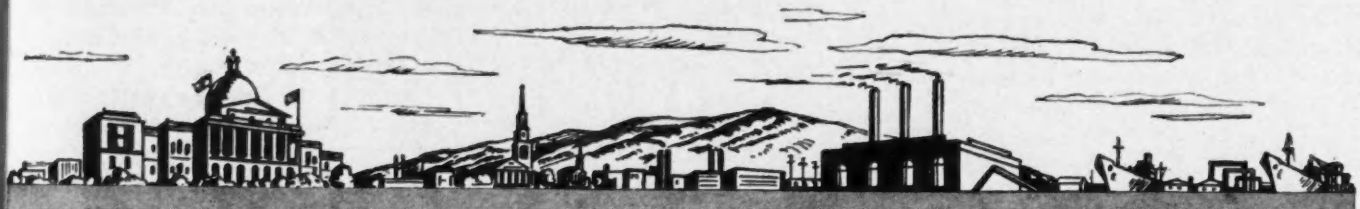
The amount of power normally interchanged by the Empire District Company with other companies, from hour to hour, has never been large. Consequently, because of the large register constant, hourly meter readings at interchange points did not re-



PHANTOM SIGNAL CIRCUITS:—To indicate power transmission line circuit breaker lockouts (left) and phase outages (right). A = repeating coil. B = station recloser. C = 32-volt station battery. D = 2,500-ohm d.c. relay. E = 3-volt drycell battery. F = single-pole toggle switch. G = door bell. H = normally closed a.c. relay. J = 45-volt radio B-battery. K = Connect to meter potential transformer.

An Engineering Executive from New England writes:

"It seems to me that an attempt to standardize heavy apparatus is timely and can be carried out without interfering with progress in design."



AMONG the responses to General Electric's proposal advocating further standardization of power apparatus, this comment from New England strikes a particularly pertinent note. It recognizes the fact that standardization need not mean the freezing of design.

Indeed, development of designs for repetitive manufacture often involves more real pioneering than a succession of "tailoring" jobs. G-E metal-clad switchgear is a case in point, where improvement continues year after year. Our wartime mass production of turbines for ship propulsion has also moved hand in hand with increasingly efficient design.

In this same letter, the writer goes on to say: "Savings in both manufacture and adaptation will certainly result from this program. We will be pleased to co-operate with you."

It is such willingness to co-operate, we believe, that will make this plan bring about lower equipment costs. Builders and users must work together. They must be willing to accept minor limitations on individual preferences for the sake of major gains over all. That is why we are anxious to have you explore the proposal with your associates, bringing to our attention any unanswered questions that may arise. *General Electric, Schenectady, N. Y.*

GENERAL ELECTRIC

201-104

flect any flow until enough had passed to move the pointer on the units dial one position. Frequently this took several hours.

When it became necessary to record this small hourly interchange for federal reports a fifth dial was added to the right side of the register at the low end of the gear train, thus reducing the constant to a point where small amounts of energy flow could be detected.

•

How to Close, Trip Circuit Breakers

5. Motor Mechanisms*

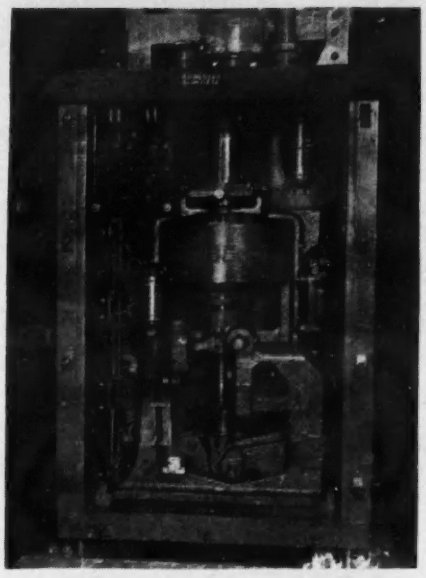
By G. J. EASLEY,
Switchgear Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Principal disadvantage of solenoid devices has always been the necessity for maintaining a large station battery. Motor-operated breakers eliminate this disadvantage since they may be operated from an a.c. supply. Early motor mechanisms were a direct-geared type. A later and more satisfactory type was the centrifugal fly-ball motor mechanism shown in the accompanying illustration. This arrangement consists of a high-speed series motor connected to a fly-ball arrangement similar to a steam engine governor. Centrifugal force causes the rotating fly-balls to separate and produce a vertical thrust on the lever system connected to the breaker. The fly-balls are located in the circular housing directly below the motor.

Both of these original motor devices were arranged to be mechanically trip free. The fly-ball type frequently coasted one to two minutes after the motor power was shut off; if the breaker opened, it remained in the trip-free position and could not be reclosed until the motor stopped. Automatic dynamic braking was often incorporated to avoid this by stopping the motor quickly.

High-Speed Reclosing

Most recent type of motor mechanism is suitable for high-speed reclosing service. The motor drives a worm-and-gear arrangement connected to the breaker through a magnetic clutch. Operation of the clutch depends on motor speed; it does not engage until the motor reaches its normal operating speed. On a fast reclosing operation the motor is energized during the breaker-opening stroke so



CENTRIFUGAL fly-ball motor mechanics for operating circuit breakers

that the clutch picks up and reverses the breaker motion. Reclosing speeds as low as 20 cycles are possible with this mechanism, but it has been generally superseded by the simpler pneumatic mechanism.

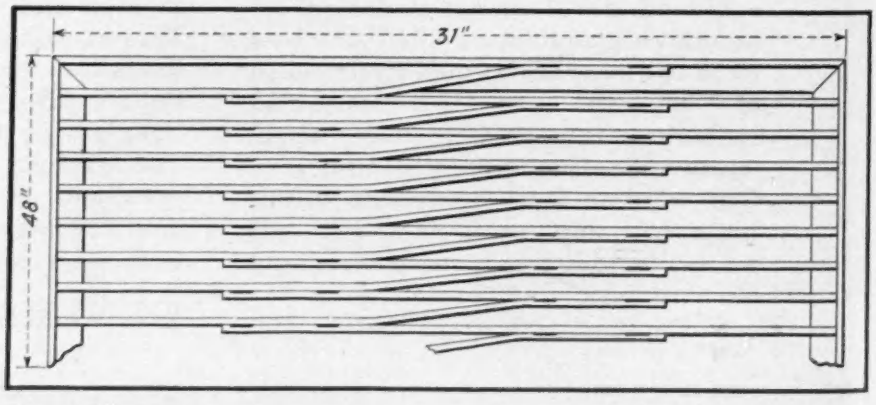
*Fifth in a series of twelve articles which began in August 7, 1943, issue of "Electrical World."

•

Ground Pads Made of Crossarm Braces

With the growing use of brackets and pole pins for distribution construction, many electric utilities are becoming pretty well overstocked with crossarm braces. Many have been sold as scrap, but there are numerous uses to which they can be put around on the system and in which they have considerably more than scrap value. One such use is in ground pads at switch-operating positions in outdoor substations, substituting for steel grid, now difficult to obtain.

The accompanying sketch shows how old braces are used to make ground pads on the system of the Virginia Public Service Company. A rectangular frame of 1¼-in. angle, 31 in. wide and 48 in. long, is first constructed, the angles to the inside. Half of the number of braces required are given a 1-in. S-bend that includes about half the length of the brace. The grill is then assembled by tack welding or bracing in the manner shown.



OLD crossarm braces make steel grill

•

Do's and Don'ts of Lead Burning

By T. G. HIERONYMUS
Superintendent of Underground, Kansas City Power & Light Company, Kansas City, Mo.

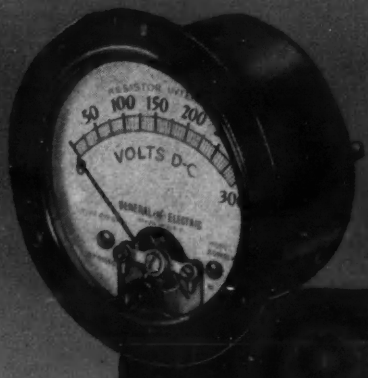
Lead burning offers the cable engineer an entirely practical and effective wartime substitute for solder wiping in making nearly all types of joints and splices in lead-sheath power cable. Experience with the technique for a little more than a year by the Kansas City Power & Light Company indicates that the skill can be acquired by the "average" cable splicer in from ten days to two weeks and that, when a few simple rules are mastered, lead burning can be done in any position and on the most complex shapes.

The time that is required to make a lead-burned joint, however, ranges from 1½ to two times that required for a wiped joint. Conservation of critical material, however, justifies the increased labor time required, it is believed.

Equipment used in lead burning is

Introducing

INTERNAL-PIVOT ELECTRIC INSTRUMENTS



...meter in a ...tal case, ...ual of DW- ...nd DW-52 ...truments. ...o available ...olded Tex- ...te case

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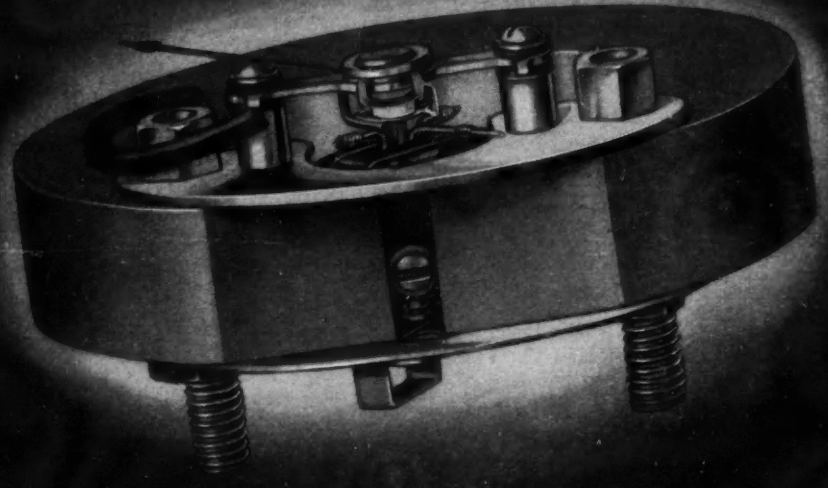
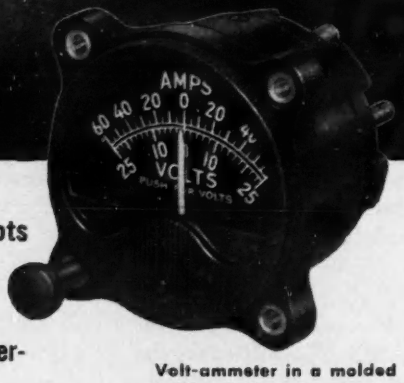


ELEMENT ASSEMBLY

(Approx twice actual size)

Note the clean, simple lines of this compact element, made possible by the internal-pivot construction and by securing all parts solidly to the cast-comal magnet.



Volt-ammeter in a molded Tex-tolite A-N case, typical of DW-53 instruments for aircraft

for **THINNESS** obtained by the use of internal pivots—pivots mounted on the inside of the armature instead of the outside

with **HIGH FACTOR OF MERIT**—resulting from a feather-weight moving element and relatively high torque

THESE new instruments are especially well suited for use in radio, other communications equipment, and naval aircraft—wherever d-c or r-f measurements are desired. In most ratings, they are approximately one inch deep.

Thinness is obtained by the internal-pivot construction. But this design affords much more than thinness.

The elements, on account of their high torque and large-radius pivots, are well able to withstand vibration. High torque combined with a lightweight moving element results in fast response. Good damping makes for ease and accuracy of reading. Large clearances help to insure reliable operation.

All these features add up to a high factor of merit and all-around fine performance.

For complete information on ratings, prices, dimensions, and specifications, ask the nearest G-E office for Bulletins GEA-4064 and 4117, or write to General Electric, Schenectady, N. Y.

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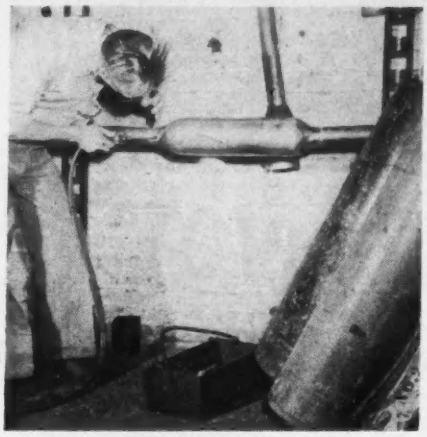


LEAD BURNING a joint at a cable splice

not elaborate. An oxyacetylene gas mixture is used, burned in a conventional torch equipped with the smallest tip available. For burning the flame should be trimmed to give the smallest sharply pointed flame obtainable and only the tip of the flame used. A blunt flame or allowing the flame to spread over a large area of work is undesirable and will result in poor work, as will be explained. Before starting to burn, strips of lead, to be used in the same manner as welding rod, should be prepared: these may be $\frac{3}{16}$ to $\frac{1}{8}$ in. square and of a convenient length for handling or for the job.

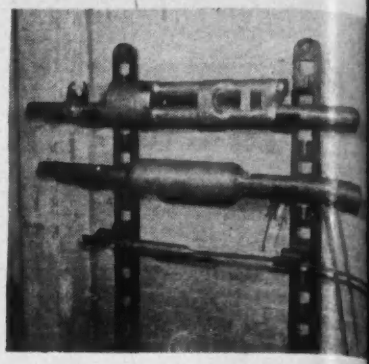
Surface Preparation

Preparation of the surfaces to be fused by burning is vitally important. Where a splicing sleeve is to be joined to the cable sheath the sleeve should first be upset and beaten down tightly against the sheath, so that the surfaces are in intimate contact. If the slightest space is left between the surfaces, surface tension of the lead, as it melts, will cause the molten lead to draw away, enlarging the space between the surfaces. Cracks between the surfaces will also form pockets, in which unburned gas can collect, preventing heat from penetrating and molten lead of the two surfaces from merging. When the two surfaces have been beaten down against each other the edges of the lead should be beveled to form an obtuse angle of about 120 deg.

Rules to Be Observed

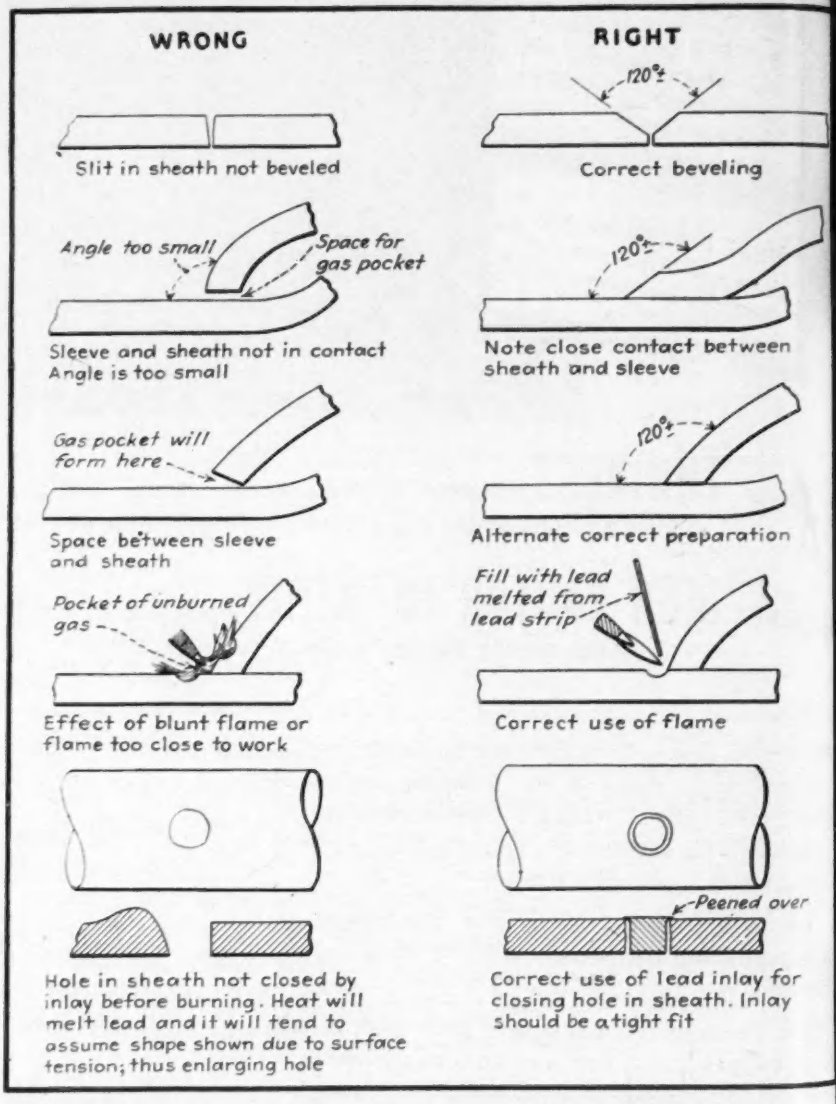
Accompanying "right and wrong" sketches illustrate the several rules which should be observed if a satisfactory joint is to be made.

1. Avoid formation of pockets of unburned gas between surfaces to be burned. Such pockets form insulating layers which prevent merging of the molten lead. This is *the* most important rule.
2. Beat surfaces into close contact.
3. Bevel the joint between two surfaces at an obtuse angle.
4. Use the smallest possible pointed flame. Avoid a blunt flame. Use only the tip of the flame for burning. The root of the flame contains a cone of incompletely burned gas that will form gas pockets.
5. To repair slits or cracks in cable sheath first bevel the edges of the slit at an obtuse angle being careful not to spread the slit.
6. Don't try to close an open hole in a cable sheath by lead burning without first filling the hole with an inlay. Application of heat will melt lead at the *edges* and surface tension will enlarge the opening. To make such a repair prepare a small inlay from sheet lead and peen it into the hole, then burn around the edges.
7. As the molten lead from the two surfaces merges build up the joint by feeding lead into the flame, using the prepared lead strip.
8. Where a space between the two surfaces is unavoidable it is helpful to bridge the space by beating a piece of prepared strip into the opening.



SAMPLE JOINTS made with lead bu

Misgivings early in the experim with lead burning, lest the applicat of heat to the cable sheath dam cable insulation, were dispelled realization that heat sufficient to d age insulation would completely stroy the sheath in the area. In manufacture of the cable the she is applied to the outside of the in lation in molten form.


WRONG
RIGHT
120°±
Slit in sheath not beveled
Correct beveling
Angle too small
Space for gas pocket
Sleeve and sheath not in contact
Angle is too small
120°±
Note close contact between sheath and sleeve
Gas pocket will form here
Space between sleeve and sheath
120°±
Alternate correct preparation
Pocket of unburned gas
Effect of blunt flame or flame too close to work
Fill with lead melted from lead strip
Correct use of flame
Peened over
Hole in sheath not closed by inlay before burning. Heat will melt lead and it will tend to assume shape shown due to surface tension; thus enlarging hole
Correct use of lead inlay for closing hole in sheath. Inlay should be a tight fit

RIGHT AND WRONG WAYS to prepare surfaces for lead burning

The Material-saving Way TO RELEASE SYSTEM CAPACITY *QUICKLY*

One of several capacitor banks in the Southwest (rated 5400 kva, 12,470 volts) being used to release power for war production.

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ONE power company after another is taking advantage of this simple and quick way of "clearing the wires" for more kilowatts. Large banks of Pyranol® capacitors are being used all over the country to relieve transmission lines and generators of reactive kva and to improve low-voltage conditions.

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Their installed cost is low—well under $10 per kva. Maintenance and operating costs are negligible.

Remember, too, that standard 15-kva individual units can be mounted on temporary structures and later utilized for pole-line mounting on distribution circuits, if future system changes eliminate the need for a larger bank—a fact that adds immeasurably to the useful life of your investment.

Ask your G-E representative for his suggestions on the applications of capacitors in large banks. He'll be glad to help you with such problems as fusing, relay protection, and switching. Or write for Catalog GEA-2746B. *General Electric Company, Schenectady, N. Y.*

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A TRIUMPH OF WAR-TIME INGENUITY. Built to WPB conserva... tion standards, these fixtures are a tribute to the inge... nuity of the lighting industry in war-time. Their ligh... weight, their sturdiness, their fine construction would recommend them even if there were no restrictions o... materials. And they point the way toward better an... better lighting when the war is over.

For some time before the first WPB order, Genera... Electric engineers had been working with fixture manu... facturers to develop new non-critical materials fo... reflectors and new light-weight fixtures. General Elec... tric is glad to have been able to contribute to the re... search that has made this progress possible.

Fluorescent fixtures bearing either of these two labels are made to rigid specifications for mechanical, electrical, and illuminating excellence; and are tested and certified by impartial experts, Electrical Testing Laboratories, Inc., of New York. You can depend on fixtures bearing these labels.

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These fixtures comply with WPB requirements and are made by manufacturers of E.T.L. Certified equipment. They are available on priorities for war plants that need them.

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Starting with Edison's first successful incandescent lamp, General Electric scientists and engineers have constantly worked toward one goal . . . to make lamps that give more and more light for the current consumed and that sell for less and less money. G-E Mazda Fluorescent Lamps are made to stay brighter longer.

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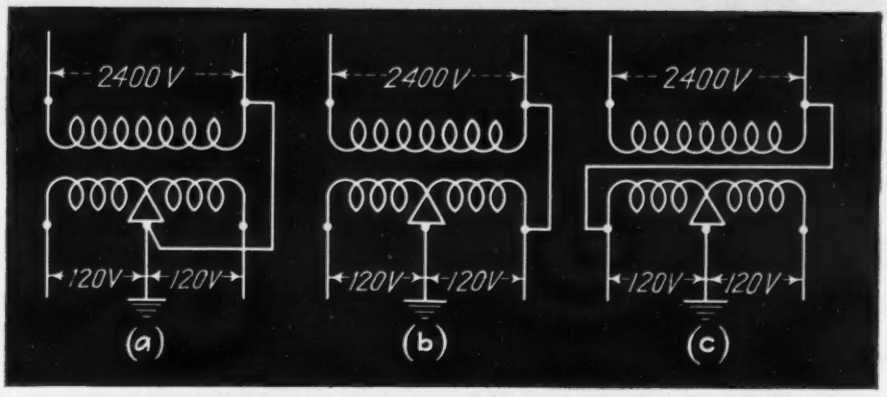
THIS COUNTRY'S FUTURE — BUY WAR BONDS

G-E MAZDA LAMPS

THREE METHODS FOR CONTROL OF VOLTAGE REGULATION IN WARTIME*

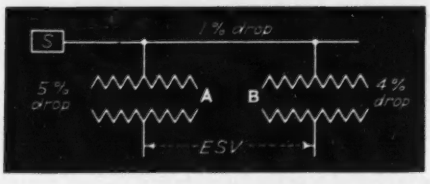


STANDARD distribution transformers on a multigrounded common neutral system to give the effect of taps; (a) normal connection, (b) 5 percent buck, (c) 5 percent boost; diagram is based on additive polarity

1. SUBSTITUTE FOR TAPS

For correcting service voltages and reducing the over-all spread of service voltages on common neutral systems, the effect of taps can be obtained from basic stock designs of 2,400-volt distribution transformers, without additional cost or equipment.

Primary current flowing in the secondary winding is so small as not to affect appreciably the load-carrying ability of the unit, especially since it flows in only one-half of the winding. In one case it amounts to 10 percent increase and in the other a 10 percent decrease of load current in the particular half of the secondary winding involved.



TRANSFORMER at A carries 166 percent load and produces 5 percent voltage reduction, at B 133 percent load and 4 percent reduction. ESV = equal service voltage. S = substation. This effect is operative in so far as loads are simultaneous at time of circuit peaks

2. SELECTIVE TRANSFORMER LOADING

By selecting transformer size with respect to amount of load carried by each unit transformers near primary circuit sources are more heavily loaded than those at outlying points, the effect being to reduce differences between the service voltage from point to point in the circuit. Transformer impedance is used to aid in reducing voltage spread by canceling a portion of the effect of voltage drop in primary conductors.

A form of selective loading commonly practiced to handle low-voltage complaints is the replacement of small transformers with larger units at far points of primary circuits. However, this frequently may result in waste of transformer capacity due to underloading. To conserve transformer capacity it may be desirable to replace transformers near the source with smaller units, then raise voltage of entire circuit by adjustment at the source, assuming that the units near the source are not extremely heavily loaded.

3. BUS REGULATION

Daily schedules for varying bus voltage in accordance with service load demands and corresponding voltage drops in the system lines and equipment are being employed, instead of holding flat voltages at generating stations and key transmission stations.

This method reduces the duty on voltage regulator facilities of local distribution systems and in many cases results in large savings in distribution investment, including avoidance of the purchase of regulators or release of existing units for use later or elsewhere on the system.

As system characteristics are modified by addition of war loads and facilities are extended, a restudy of bus schedules will be necessary to meet changed conditions. Frequently it has been found that adjustment of voltage levels by changing fixed transformer taps here and there permits a wider variation of bus voltage, and more use of the bucking range of regulators, and the low excitation range of generators, than otherwise would be possible. Fixed boosters provide the same type of assistance.

Additional information on this method is outlined in an article "System-Voltage Programs Release Capacity Margins," on page 62.

* Practices of various utilities.

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Small Diameter

BUILDING WIRE

FLAMENOL BUILDING WIRE, TYPE SN

Flamenol thermo-plastic insulated small-diameter wire, Type SN, is available in sizes 14 to 1,000,000 CM. (Resins are now permitted for electrical conductor insulation wherever copper is allocated.) Its small diameter, comparatively light weight and smooth finish make it easy to handle. It will give long dependable service.

Flamenol Building Wire was developed before the war. It has been used for a number of years in all sorts of buildings. *It is ideal for maintenance work, for rewiring or for new wiring.* It is approved by the Underwriters'. Its insulation is superaging, high in dielectric and mechanical strength, flame retarding and resistant to oils, moisture, acids, etc.

FOR FURTHER INFORMATION on Flamenol Building Wires, Loom Bus-drop Cable, Conduits or Wiring Devices see the nearest G-E Merchandise Distributor or write to Section W1032-9, Appliance and Merchandise Department, General Electric Co., Bridgeport, Conn.
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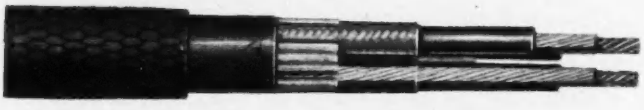
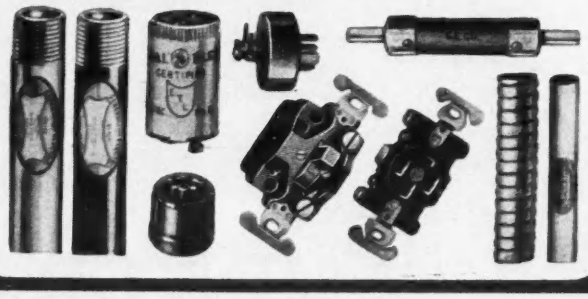
G-E LOOM BUS-DROP CABLE



G-E Loom Bus-Drop Cable can be hooked up quickly from LVD or bus-duct systems to machines. It is flexible and easy to handle. Use it for maintenance work, rewiring or new wiring. This is rugged cable and will give long service. It will withstand vibration and rough usage.

G-E CONDUITS AND WIRING DEVICES

General Electric also offers for war wiring needs: G-E White hot-dipped galvanized conduit and G-E Black enamelled conduit, EMT, flexible metal conduit and hundreds of switches, lampholders, outlets, fuses, etc.



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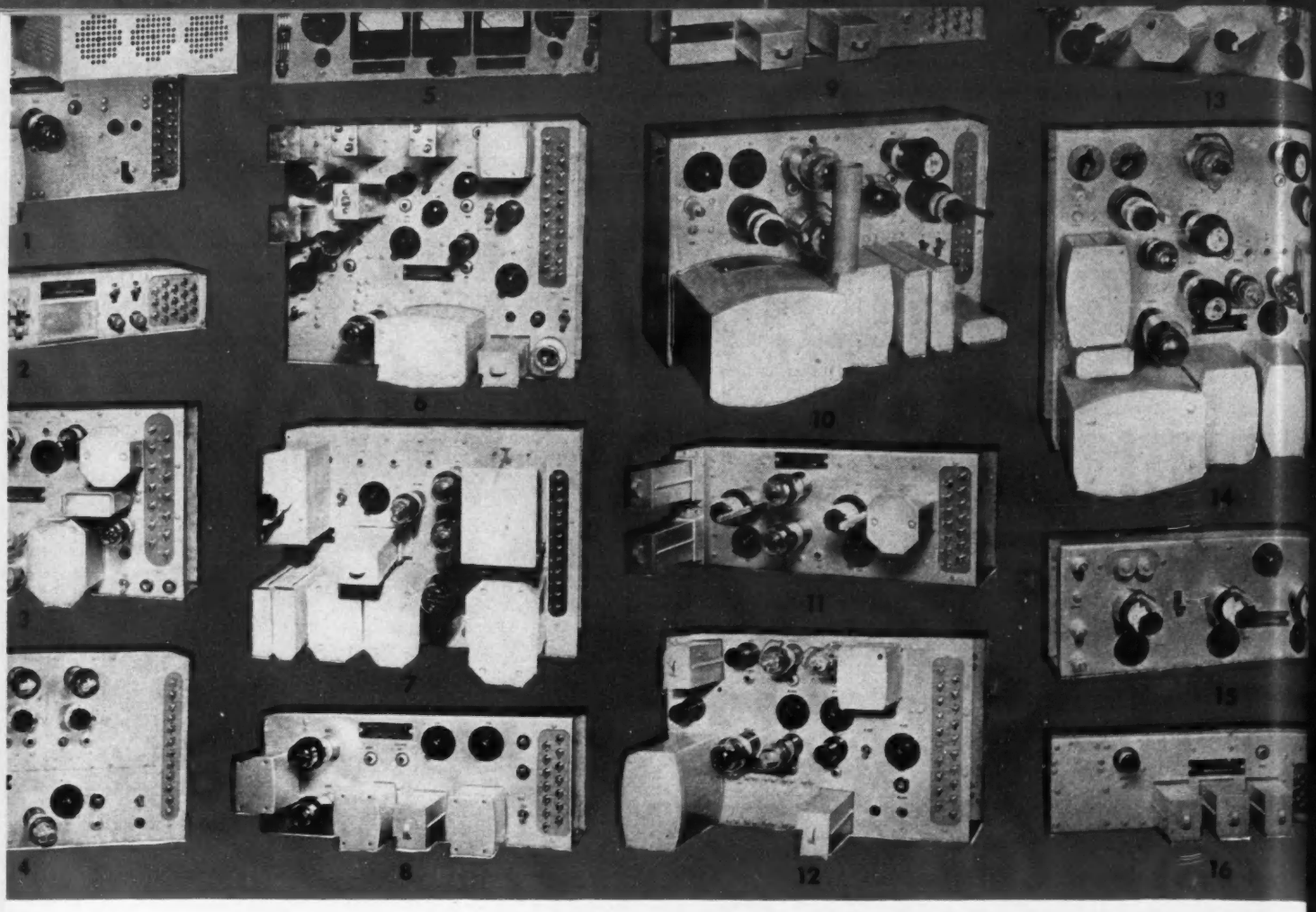

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Compact, efficient, and uniform in high quality and engineering, each combines electrically and mechanically with one or more of the other 77 units — and with standard cabinets of convenient size for indoor or outdoor installation.

No other carrier equipment offers such flexibility in design or function. Whether your requirements are met by an assembly the size of a suitcase or the 24-unit equipment at the right, future needs for more or different carrier-current services will be accommodated easily and economically.

Major carrier functions include pilot relaying, transferred tripping, supervisory control, telephony, telemetering and automatic load control.

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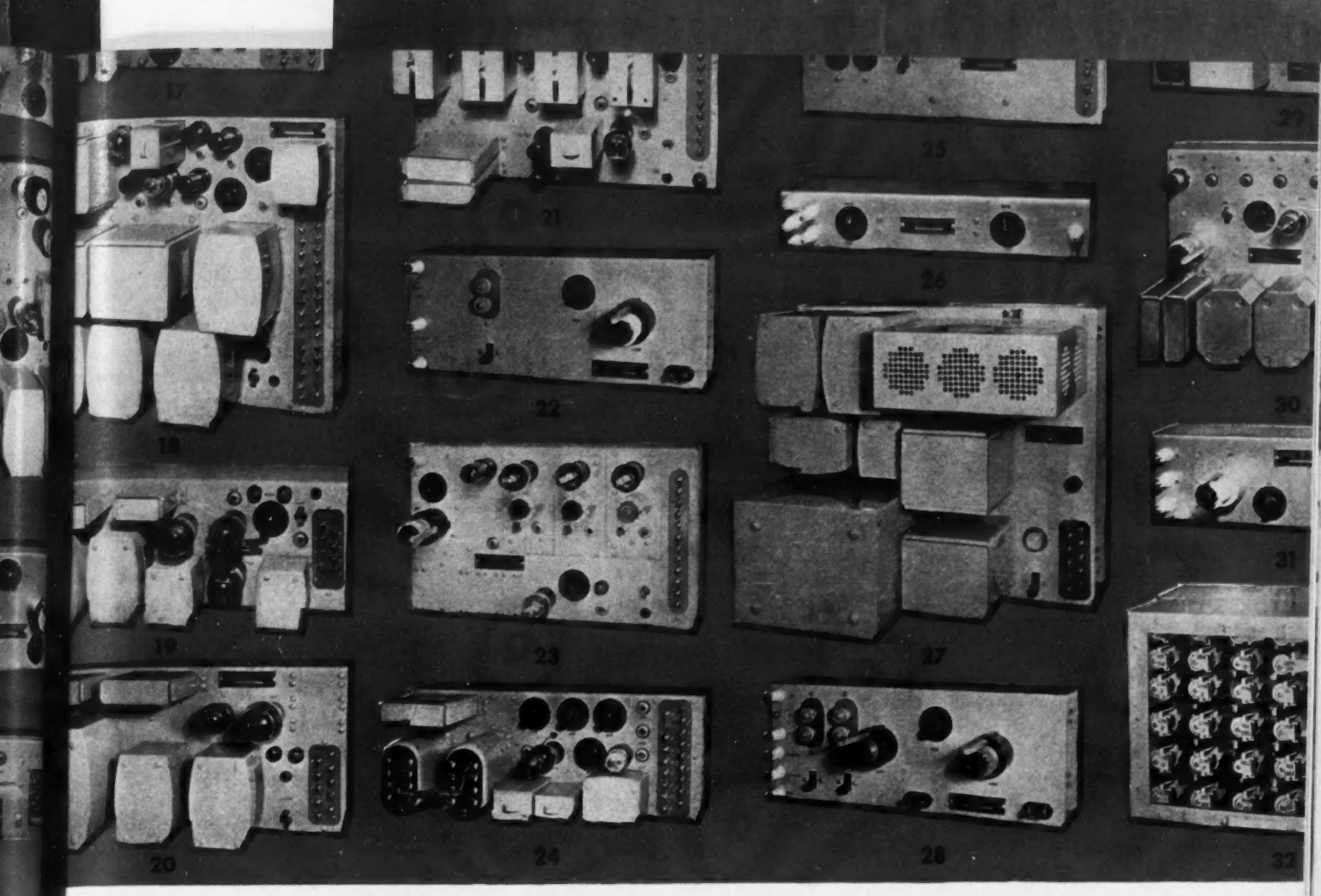

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4. Telemetering transmitter.
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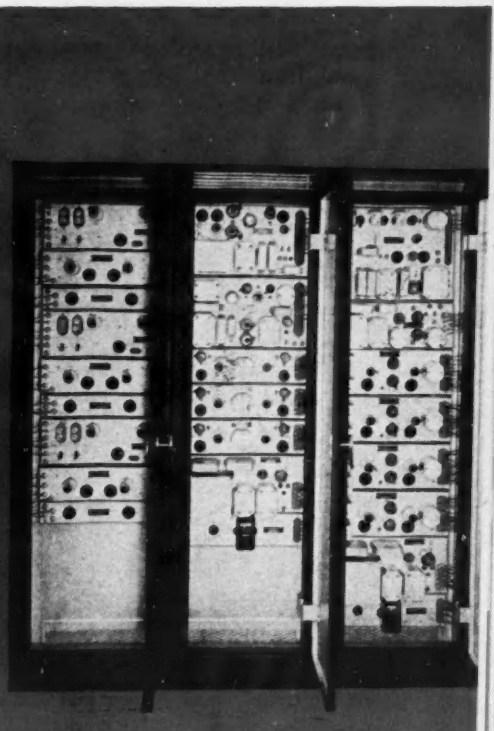
6. Superheterodyne receiver.
7. Supervisory control transmitter.
8. Relaying modulator.
9. Simplex telephone auxiliary.
10. Transmitter, 50-150 kc.
11. Audio filter and relay.
12. Single-frequency duplex telephone control.
13. Audio oscillator.
14. Transmitter-modulator, 50-150 kc.
15. Two-frequency line tuning.
16. Simplex telephone auxiliary, 800-cycle, ringing.
17. Single-frequency duplex telephone code ring.
18. Power supply for selective ringing.
19. Audio amplifier.
20. Power supply for audio units.
21. Telemetering or control receiver.
22. Single-frequency ground-return line-tuning unit.
23. Load-control or supervisory transmitter.
24. Two-frequency duplex telephone control.
25. Input-voltage control.
26. Impedance matching transformer.
27. Power pack for carrier-frequency amplifier.
28. Interphase line-tuning unit.
29. Telephone-line protective-and-jack unit.
30. Telemetering or control transmitter.
31. Double trapping unit.
32. Selective ringing unit.



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CARRIER CURRENT

THE NERVE NETWORK OF THE POWER SYSTEM

Tacoma's Tide Flats Substation Renovated

By PHILLIP A. BROWN, R. J. PANGBORN
Engineers Tacoma City Light,
Tacoma, Wash.

The Tide Flats area load, which comprises 60 percent of the city of Tacoma's system total, since 1937, has grown so much more rapidly than the loads in other parts of the system that substations have had to be expanded to more than double their size in this area. Ninety-five per cent of the above load is served by the city's Tide Flats substation.

In 1939 a load study was made and it was decided to install two 36,000-kva., 110/13-kv. transformer banks, two 42,000-kva. 110/55-kv. auto transformer banks and two 20,000-kva. outdoor condensers.

In 1940 and 1941 a new 110-kv. connection was made to the Bonneville system and the Seattle and the Cushman substation 55-kv. tie lines were reinsulated for 110 kv. This necessitated the establishing of 110-kv. buses at the above station, also crossing over the Hylebos waterway on galvanized 220-ft. double-circuit steel towers anchored on pile and concrete foundations, and continuing on galvanized steel towers for 1½ miles to wood-pole lines for the two inter-system connections.

As a result of all these expansions the old control house was too small to house the additional switchboards and equipment; it was decided to build a new two-story control house around and over the old one.

The first procedure was to erect a wood frame building inside the old building of hollow clay tile construction, because the roof, ceiling and two outside walls had to be removed before the new building could be started. This allowed use of part of the foundations of the old building on which to construct the new one and use of the old cables and ducts.

Some of the inside walls of the new building had interference from the switchboard. This necessitated dividing the switchboard and rearranging the sections, to provide additional space. This was done by opening the trip circuits of the relays, lashing the sections of board together and moving it with block and tackle to a temporary position. Footings were then excavated, forms erected and concrete poured. In a few cases the footings for the pilasters of the new building had to be constructed adjacent to the switchboards. In these cases the old wood floor had to be carefully removed and excavation done entirely by hand, so as not to jar the relays.

After the first story and second floor of the new buildings were poured and glass block windows installed, the old walls and false ceiling and forms on the new walls and ceilings were removed. The walls of the old building were then removed, using the new building as the inclosure. A new electric heating system, consisting of a bank of "Calrod" heating elements arranged behind blowers, were installed to furnish heat for the workmen.

Next, the second story was constructed, and glass block windows installed. The old switchboard was divided into three sections when it was moved to the second floor because new panels were added for the new auto-transformer banks, condensers, second Bonneville tie and five additional 13-kv. feeders. Extra panels were on hand to move the 13-kv. feeder panels, but control cables had to be spliced out to accommodate the new panel location. This was done with no shutdown or outage of any feeder. In some cases the feed to various feeders was by-passed through bus tie breakers in order to have relay protection while the changeover was taking place. Control cables had to be rerouted to cut down their length and to relieve overcrowded duct banks in a few cases.

At present the new building is completed with the exception of the extension of some control cable ducts, laying of the linoleum and miscellaneous other small items.

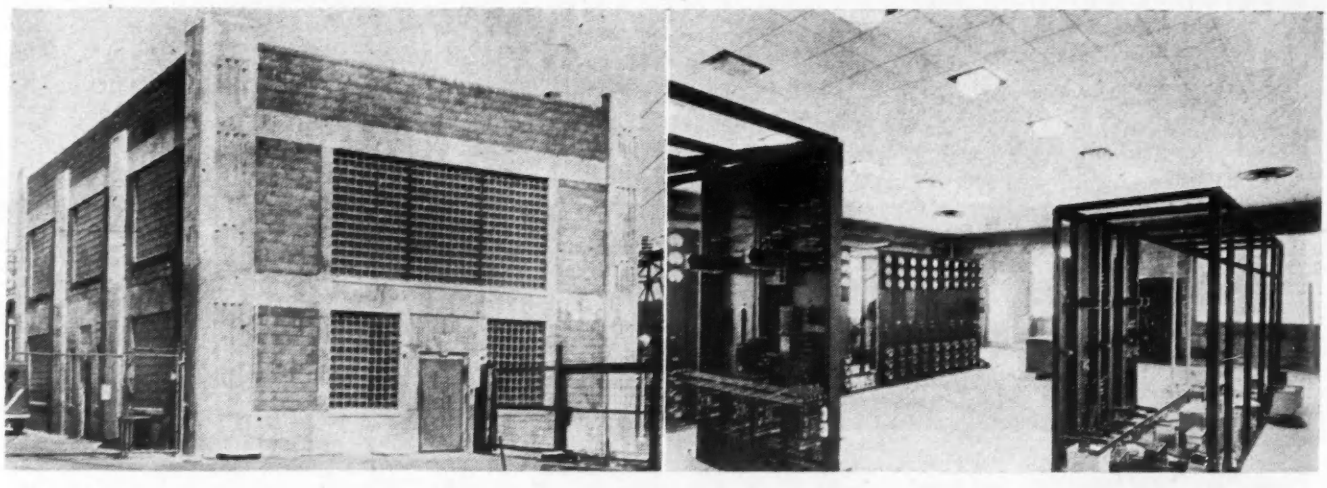
•

You Can Repair That Burner Casting

Pulverized fuel burner castings that have been damaged as a result of powdered coal piling up, coking and burning through the relatively thin metal casting can be restored to usefulness by a simple repair that has been used successfully for some time as a conservation measure at stations of the Louisville Gas & Electric Company.

Procedure followed with the 30-in. diameter, 2½-ft. burners at Louisville, for example, has been, first, to chip away *all* of the burned cast metal, back to the clean iron. Using a draw shave, a wooden pattern is then made up to conform to the curvature of the burner casting and from it one or more plates about ¾ in. thick and of convenient size are cast. A number of such plates in one or more sizes can be cast up at one time for future use if desired.

By successively chipping out the



EXTERIOR of new concrete and glass block substation and switchboard sections, 75 percent complete, in new 2d-floor location

EVEN THIS CONDITION

can't stop the dropout action of L-M PVD FUSE CUTOUTS

because their operation is entirely independent of any door action. Thus, even if the door is solidly frozen shut, the PVD still operates as a disconnecting, dropout cutout. Because the door remains shut, internal parts are always protected from the weather. When a link blows, the PVD cartridge drops down to serve as a positive indication of the cutout's blown condition, visible from any direction.

In the PVD, when a link blows, the flip-out device instantly snaps the unburned link leader clear of the cartridge, extinguishing the arc before the contacts separate. The large air-gap formed when the cartridge drops, prevents any arc re-establishment.

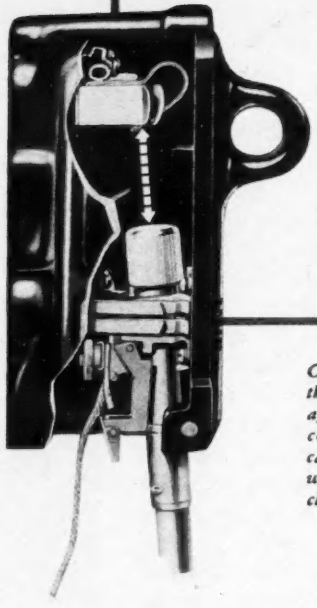
Your L-M Field Engineer can tell you why this all-weather fuse cutout will best suit today's conditions. Ask him, or write Line Material Company, Milwaukee 1, Wisconsin.

There is a complete range of L-M PVD type fuse cutouts. They are available in the following sizes:

	Volts	Amp.
PVD-56	5000	50
PVD-76	7500/12500	50
PVD-515	5000	100
PVD-715	7500/12500	100

And for repeater service, having the same disconnecting, dropout action the:

	Volts	Amp.
RP2-56	5000	50
RP-515	5000	100



Cut-away view showing how the PVD cartridge drops out after the link blows, to disconnect and serve as an indication of the blown condition, with the door remaining closed.

LINE MATERIAL COMPANY

hole in the casting and grinding down the cast plate it can be fitted into the hole to be filled. It is desirable, however, to dress the edge of the repair plate to give a clean metal surface for welding. At Louisville a cast-iron electric welding rod is used to join the repair plate and the original casting, although other types of welding should serve as well. The weld is there, of course; ground smooth.

Burner castings repaired in this manner can be either restored to immediate use in the boiler or can be set aside for use as spares in the event of an emergency.

•

Precautions in Welder Service

By C. N. CLARK,
Distribution Engineer, Duquesne Light Company

To prevent, as far as possible, lighting flicker and low voltage at the work, the Duquesne Light Company has set up a series of definite precautions to be observed in service to resistance welders. They are:

1. *Obtain complete data on welder and application*—These data include the current and voltage to be drawn under both maximum and proposed conditions, also the number of welds per minute and the number and frequency of impulses for the proposed conditions.

2. *Determine the kva. fluctuation limit*—Taking into account the proposed welder operating cycle, determine the maximum permissible kva. which could be permitted for each of the available methods of supply. This will be governed by the voltage flicker standards of the power company.

3. *Select the method of supply*—Compare the fluctuation limits from (2) with the proposed welder duty from (1), and select from those having permissible limits in excess of the proposed welder duty the one which has the lowest cost (in wartime, the one which requires the least amount of critical material). Provision for possible higher welder duties in the future should be made, where cost differentials are small.

4. *Choose the transformer size and location*—The distribution transformer should be located as near as practicable to the proposed welder or welders. In most cases the transformer size should be equal to the nameplate rating for a single welder, and should be equal to or greater than the largest of a group of welders.

5. *Install adequate secondary wiring*—The customer should be advised that his secondary wiring should be short and of such size as will provide adequate current carrying capacity and limit the voltage drop to a reasonable value, usually less than 3 percent, but permissibly greater if other drop is low.

6. *Provide suitable metering equipment*—Considering the welder load by itself it must not be forgotten that the load factor is very low, the investment in the power supply system is large, and the revenue is small. Metering errors for fluctuating loads of this type are very large, with some old types of meters, and it is important that the proper size and type of meters and instrument transformers be chosen so as to minimize these metering errors.

7. *Make tests in the field*—In order to become familiar with power requirements for welders it is important that some welders be inspected after being placed in operation, and that tests be made to determine how closely the actual duty and operating cycle conform to the original specifications for which the electrical system was designed. This also provides an opportunity to check the results of earlier calculations.

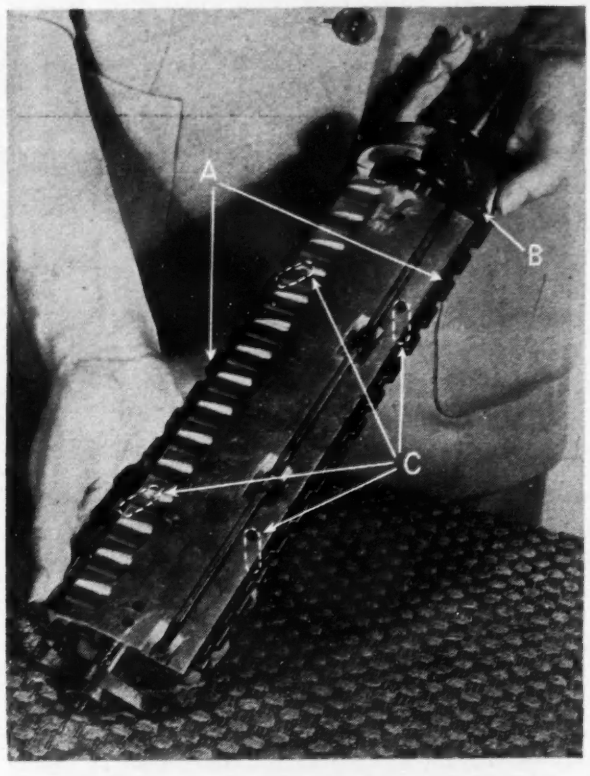
•

Collapsible Arbor Speeds Coil Winding

An adjustable, quick-releasing arbor for winding random coils for instrument type motors has speeded the job and increased machine availability at one of General Electric's plants manufacturing aircraft parts.

The arbor was developed by F. W. Smith, a tool designer. Referring to the illustration, the arbor consists of two notched rails (A) over which the coils are wound, and a cam-ground surface on a lock nut (B) at the end of the arbor which moves the rails longitudinally. In each rail there are two cam slots (C) in which are located two guide pins which are firmly attached to the body of the arbor.

As the cam is turned, each rail is forced against the guide pins and the slot acts as a cam surface to force the rails outward to the position in which the coils are wound. The arbor is then completely wound with coils in an automatic machine. When the winding is completed the cam is turned back to the semi-relaxed position and the coils are tied, after which the cam is rotated until the slot in the cam is opposite the end of the rails. The rails then fall back to a reset position below the body of the winding fixture so that the coils can be removed from the arbor.



ADJUSTABLE section arbor for winding random coils

An important advantage of this type of arbor lies in the fact that coils for this particular type of motor are wound continuously in three phases of five coils each. The arbor permits three spools of wire to be used and three coils are wound simultaneously.

We* will work with you on any problem involving the use of...

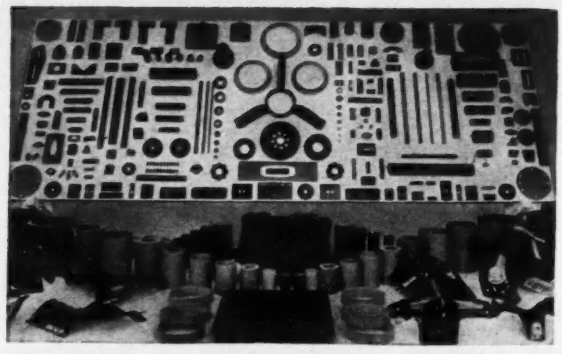
STRUCTURAL LAMINATED RESINOUS plastics

FRANKLY, up to now the Panelyte Division of the St. Regis Paper Company has been too busy "growing up" with important users of our laminated plastics to take time to talk about our successes. Instead of broadcasting each advance, we have quietly continued working in close cooperation with customers—producing a variety of grades of structural laminated resinous plastics for specific applications—assisting in the more efficient design of parts—and molding and fabricating them by mass production methods.

Through this simple—but sensible pre-Pearl Harbor method of operation—PANELYTE became America's largest producer of thermo-setting molded laminated plastic parts, serving the automotive, chemical, electrical and refrigerator industries. Our "down to earth" slant on plastics and our way of working enabled us to step up production to meet vastly increased War demands.

Because we produce a wide range of laminated plastics in sheets, rods and tubes (paper, fabric, wood veneers, glass fabric and asbestos base types), molded forms, and fabricated parts, and because we have *"waited to see" the performance record of each application,* we know what PANELYTE Plastics can—and cannot do . . . and our engineers base their recommendations accordingly.

Our mass production facilities and technical information may prove most valuable to you if you are looking for an improved—or perhaps less expensive—structural, mechanical or electrical part. Our engineers will work with you on any problem involving the use of thermo-setting laminated plastics.



Illustrated are some of the 2000 parts we are manufacturing for the aviation industry. PANELYTE, mechanical and electrical parts are used, also, by the Navy, Signal Corps and Direct Service Procurement.

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Look out for 20-mile-to-the-gallon autos ... new machines of startling power ... streamlining efficiencies ... war-developed devices, now booked ... no end of jobs in smart plants (where recourse to Arc Welding is the rule).

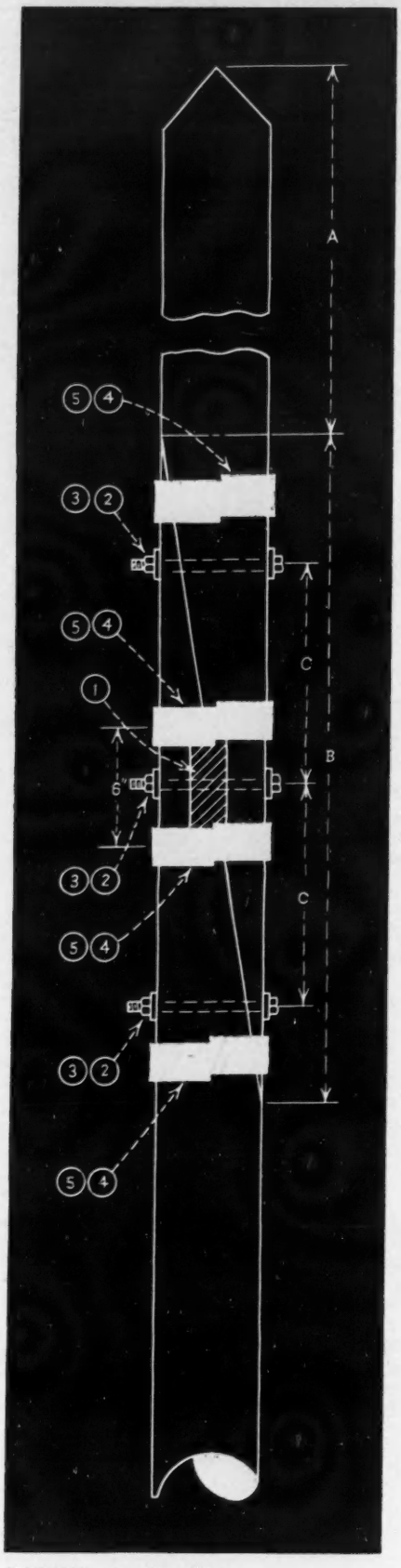
Recourse: According to Webster, "*a going to for aid or protection*"

HOW ONE COMPANY MAKES A POLE SPLICE

A. MacDONALD, Overhead Engineer Bureau of Power and Light, City of Los Angeles

A method for making a pole splice applicable particularly when an extra length is added for a pole extension has been standardized by the Bureau of Power and Light of the city of Los Angeles.

Dimensions of splices for various extension lengths and splicing material required are given in the accompanying tables. The splice is shown schematically in the illustration. All surfaces of the pole and extension are painted before assembling. Bolts are cut off flush with nuts. Twelve turns of No. 9 galvanized iron wire are used to form each of four bands on the splice.



OUTLINE of pole splice

Pole Splice Dimensions

Extension Length A	Splice Length B	Bolt Locations C
5 ft.	4 ft.	1 ft. 4 in.
10 ft.	5 ft.	1 ft. 8 in.
15 ft.	6 ft.	2 ft.
20 ft.	7 ft.	2 ft. 4 in.

Material List

Item	Description	Quantity
1	2x6x12-in. Hardwood block	1
2	5/8x12-in. galv. bolts	3
3	2 1/4x2 1/4-in. washers	6
4	No. 9 galv. iron wire	125 ft.
5	1 1/2-in. fence wire staples	24

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Why do the men in the armed services of our own, and other countries, prefer Marmon-Herringtons, so generally, for the extra-difficult jobs? Possibly because Marmon-Herrington *All-Wheel-Drive* trucks are *not war babies,* having had the "bugs" worked out in more than ten years of manufacture before the war began. Marmon-Herrington led the industry in improving the design and performance of heavy-duty multiple-drive trucks, following the first world war. It was Marmon-Herrington, too, that originated the conversion of standard mass production trucks and passenger cars (forerunners of the modern Jeep) to *All-Wheel-Drive* years before the present war started. Naturally, these pre-tested vehicles provided superlative performance from the start, and endeared themselves to thousands of men who will demand the same "plus qualities" in the trucks they drive when the war is over. Their assurance will be the name, Marmon-Herrington, when they buy.

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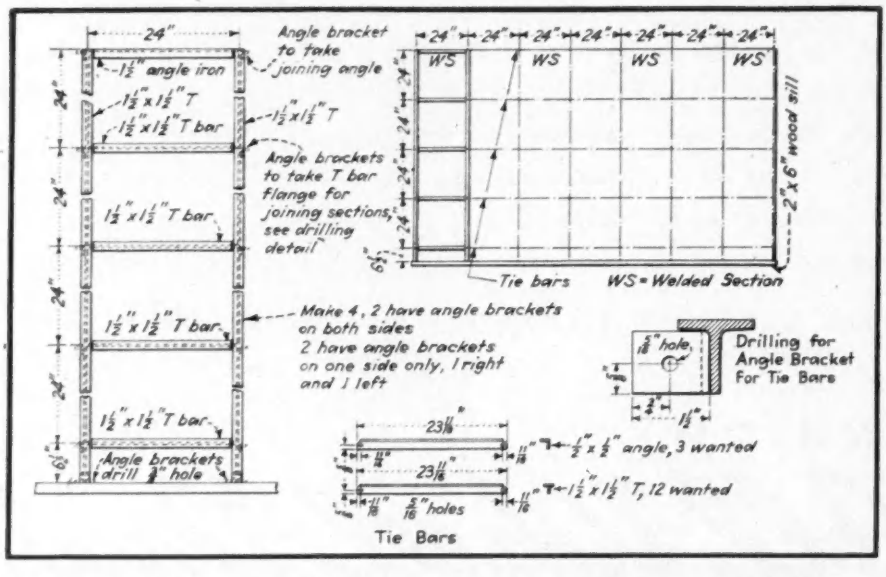
Framing Design for Dispatchers' Board

By WILLIAM NOYES
Operating Engineer,
Public Service Co. of New Hampshire

The load dispatchers' board at the Manchester headquarters of this company, while located in a room too small for satisfactory photographing, received special consideration as to framing design and system diagram make-up. The framing is made of four welded sections of T-bars, held apart by tie bars bolting the welded sections together, the over-all length and height of the board being 14 ft. x 8 ft. 6.5 in. respectively. The framework is clamped between a 2 x 6-in. wood sill on the floor and a beam which protrudes beyond the partition wall at ceiling height. The board is divided into panels 24 in. square and is seven panels wide and four panels high. These are of metal $\frac{1}{8}$ in. thick and are held at each corner by 12-24 machine screws $\frac{3}{8}$ in. long with $\frac{1}{2}$-in. oval heads tapped into the frame, so that in the middle of the board each screw catches the corners of four panels.

The panels are sprayed with a flat finish light green paint, a color designated as "Sea Foam," pleasing to work with. A wooden mop board is provided at the bottom and the entire board is framed with a quarter-round molding. The diagram uses conventional symbols about 0.4 in. across. Transformer banks are 1 in. long and transmission lines 0.1 in. wide. Oil coach colors designate the line voltages: orange, 66 kv.; red, 33 kv.; blue, 13.2 kv., and black drawing ink for lower voltages, buses and apparatus. Lettering is done with "Wrico" guides. The pins are the largest size Moore map tacks with $\frac{1}{4}$-in. heads, snipped off to about 1 in. length, and to care for the pins the board was drilled with a No. 60 drill. Care had to be taken in laying out the diagram to avoid hitting the framework with the small-sized drill. Minor changes are made with knife and eraser, which do not injure the background. Pressboard was tried for panels, but changes are not easy to make without showing. The dispatchers' position is about 10 ft. from the board.


24"
Angle bracket to take joining angle
1½" angle iron
1½"x1½" T
1½"x1½" T bar
Angle brackets to take T bar flange for joining sections, see drilling detail
Make 4, 2 have angle brackets on both sides
2 have angle brackets on one side only, 1 right and 1 left
Angle brackets drill ⅜" hole
WS
2"x6" wood sill
Tie bars
WS = Welded Section
⅜" hole
Drilling for Angle Bracket For Tie Bars
23 11/16"
½"x½" angle, 3 wanted
½"x1½" T, 12 wanted
11/16" ⅝" holes
Tie Bars

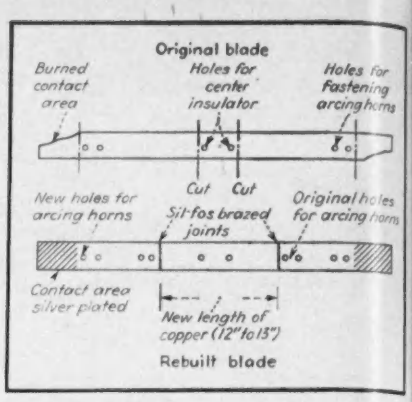
DETAILS of framing for load dispatchers' system diagram board at Manchester

•

Burned Switch Blades Completely Rebuilt

Accompanying sketches show how the horizontal blades of high-voltage, double-air-break disconnect switches which have been seriously pitted or burned in service are reclaimed using original blade material at the reclamation shop of the Oklahoma Gas & Electric Company.

Burned contact areas at the two ends of the blade are first trimmed off. Remaining portion of the blade is then cut into three pieces by making two saw cuts, one on each side of the bolt holes by which the blade is fastened to the swinging center insulator. The two end pieces are turned end-for-end and a new center piece added, which is drilled for the center insulator support. A sufficient length of new copper strap is added in this center portion to make up for the original contact portion trimmed off.



BURNED BLADES of high-voltage, double-air-break switches reconditioned with a minimum use of new copper

Blade end surfaces which meet the stationary contacts are silver plated by the brush method. Stationary switch contacts, when badly damaged, are built up with phos-copper alloy, smoothed on a belt sander and silver plated.

Reconditioned in this manner the switch blade requires only two brazed joints and something over ¾ of the copper in the original blade is reused.

•

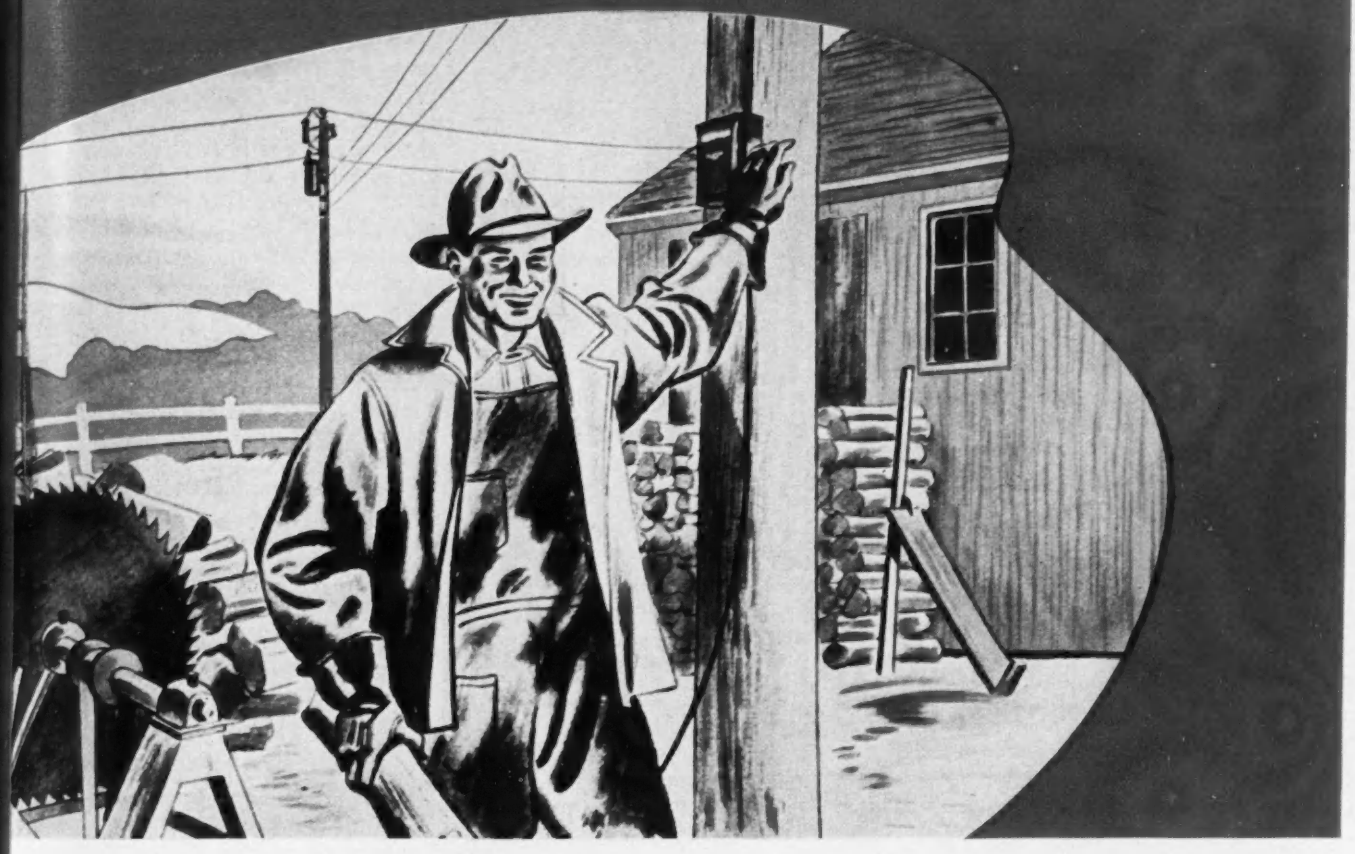
Activated Alumina for Purifying Oil

By HOBART E. ROWE,
University City, Missouri

One of the methods of purifying insulating oil involves the use of activated alumina. This is a stable substance (Al_2O_3) which in physical appearance resembles porcelain. It has the ability to absorb water and acids which it will release when heated (reactivated) to about 400 deg. C. It has been used for seven years on one system in transformers totaling 320,000 kva. containing 100,000 gal. oil, which requires changing 10,000 lb. of activated alumina annually. Total oil maintenance cost in this case has been $0.0147 per gallon oil per year for the more severely overloaded equipment and $0.0065 for the lighter loaded units. Some units are 15-20 years old. For details of this particular application see "Activated Alumina Holds Quality in Insulating Oil," by J. Elmer Housley, in ELECTRICAL WORLD, May 18, 1940, page 55. Activated alumina is used in three ways in effecting preventive maintenance.

1. It is used in a breather to absorb mois-

KEEPING THOSE POWER LINES "Hot" HELPS OUR FIGHTERS



An uninterrupted flow of electricity to the farm and manufacturing fronts means more food, more supplies for our fighting fronts. So keep those power lines on the job. They'll help compensate for the labor that's been lost.

You can obtain materials and supplies needed for proper maintenance and emergency repair of your A.C.S.R. lines. Alcoa has been authorized to carry an adequate inventory of these materials in stock, so we can make prompt shipment on orders bearing proper authorization. The form of certification required is provided in the WPB Utilities Order U-1.

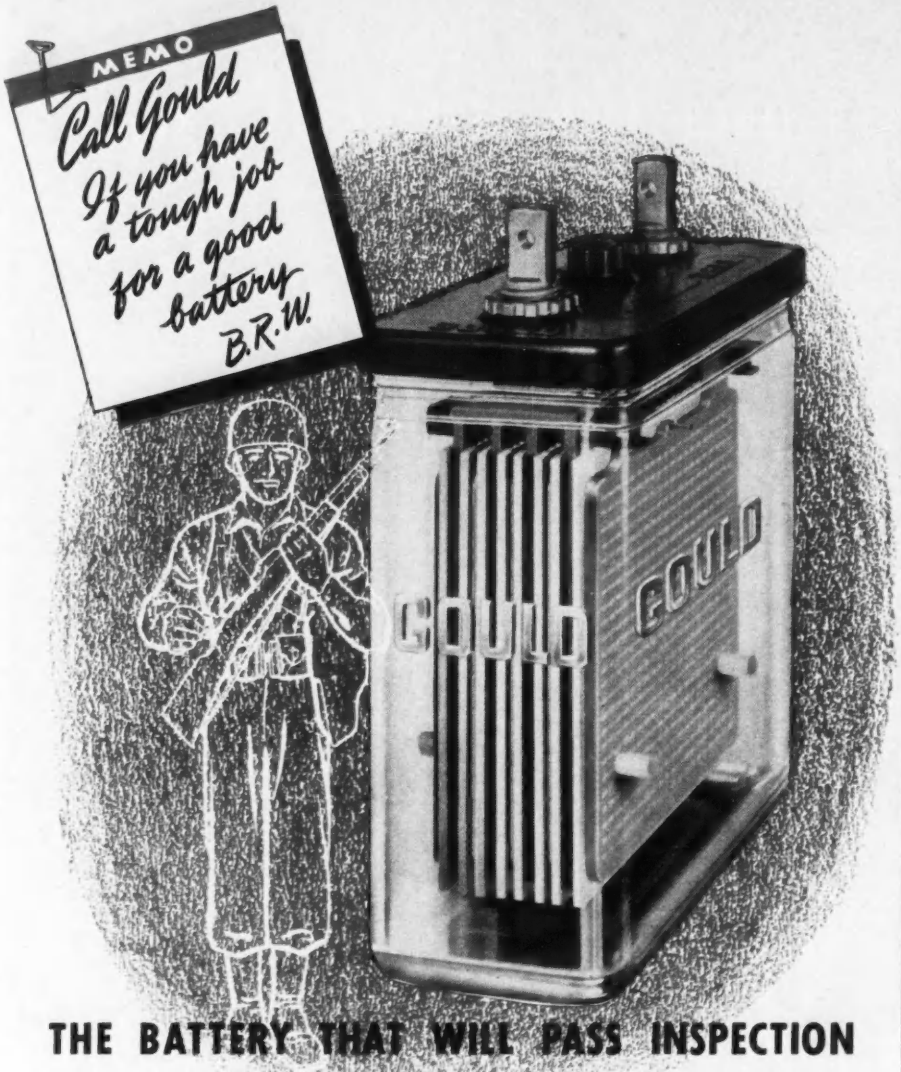
A.C.S.R. power lines—Aluminum Cable Steel Reinforced—are playing an important part in our country's war effort. These conductors are on many of the steel tower, high voltage lines you see stretching across country. They form vast rural networks. A.C.S.R. provides the high conductivity, high strength and resistance to corrosion that makes the enviable performance of these lines possible.

If you need help in placing repair orders, or on any other maintenance problems, write ALUMINUM COMPANY OF AMERICA, 2138 Gulf Building, Pittsburgh, Pennsylvania.

IMAGINEERING AT WORK

ALCOA A·C·S·R

ALUMINUM CABLE STEEL REINFORCED



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Since 1898 THE BATTERY PICKED BY ENGINEERS

CHECK WATER

One of a series of service suggestions for users of industrial batteries.

▶ An essential in the maintenance of your storage battery is the addition of pure water to keep the plates covered. This is important in all types of batteries because that portion of the plates extending above the water level is not taking part in the charging and discharging operations. In other words, the capacity of each cell is reduced in direct proportion to the exposure of its plates. In stationary applications low water level will also upset the floating characteristics of the installation.

A low water level also means a greater concentration of acid within the cell. Should this strength exceed 1.300 Sp. Gr. the acid will attack wood separators. Rubber separators are not affected but in all types the stronger the acid the greater will be the effect of local action, or self discharge.

The water used in "filling" should always be added after hydrometer readings have been completed and before charging operations are started. This is because water is less dense than the electrolyte and will remain on top until some movement or the gas generated by the battery on charge causes it to mix.

Distilled water should be used where obtainable. As a substitute rain water is good, but not if collected from a metal roof. Metals, particularly iron, copper and nitrates, are the chief impurities in water which will harm the battery and should be guarded against whenever possible.

If you fill your battery with city water (and many companies do) check first with the Gould laboratory. Send us a sample of the water you use or propose to use, and let us make an analysis. We will send a report with our recommendation as to whether or not you should use it. There is no charge or other obligation for this service.

We would like you to know the Gould men who will take care of your industrial battery requirements.

Serving the Eastern Great Lakes area are the following: H. G. Frank, 13906 Rugby Road, N. E., Cleveland, Ohio; C. E. Smith, 35 Neoga St., Depew, N. Y.; R. K. Degener, 6432 Cass Ave., Detroit, Mich. In this same area is Stanley H. Smith of the Stanley H. Smith Co., 810 Republic Bldg., Cleveland, Ohio, a special representative.

(Advertisement)

ture, preventing its entrance into the transformer. In this application it carries an indicator which changes color when saturated with water. Visual inspection through a window in the breather indicates when a new change should be installed.

2. It is either immersed in a sack or perforated can in the transformer oil or placed in a thermo-siphon attached to the transformer. Here it absorbs the products of oxidation.

3. It is installed in a sack in the upper part of the bushing to maintain bushing oil.

In these applications it has the following advantages:

1. Moisture, which enhances deterioration, is excluded.
2. The acidity of the transformer and bushing oil is maintained at such a low concentration that sludge does not form.
3. Activated alumina may be readily reactivated, which contributes to the economy of its use.
4. Transformer need not be de-energized to be serviced.
5. No bulky, heavy equipment need be transported from substation to substation. Servicing can be carried out by the use of a passenger car or light service truck.
6. No source of power is required for pumps and heaters.

Liabilities of using activated alumina are:

1. A special breather must be used to accommodate the alumina.
2. A decreased emulsion resistance may accompany the use of activated alumina in the oil. However, this cannot be considered serious as no water is present to emulsify when an activated alumina breather is used.

If used oil is to be reclaimed by circulating through activated alumina the pounds of activated alumina required are calculated by the following formula:

$$P = 0.412 \times N \times G$$

where P= pounds, N = neutralization number and G = gallons of oil.

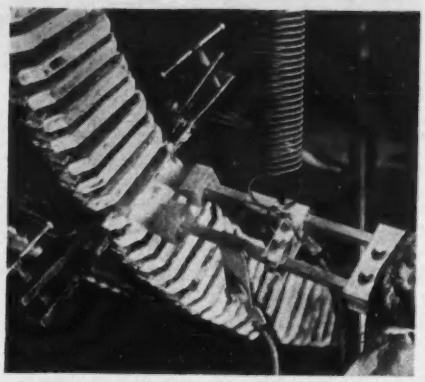
This article concludes a series on characteristics of oil purifiers; three other purifiers, viz., blotter filter press, centrifuge and fuller's earth filter, were outlined in ELECTRICAL WORLD in issues of August 21, September 4, and September 18, 1943.

•

Heat for Soldering Large Connectors

Heat for soldering large connectors, up to ¾x2 in., can be furnished readily by using a welding transformer. Terminals of the transformer are connected to two welding carbons held in suitable handles. Although the tool is relatively light, easier handling can be obtained by suspending it from a heavy spring.

In the past large connectors were heated by passing current from a carbon through the connector and to a copper wedge lodged against the connector. By passing the current from the carbon, through the connector and to the other carbon, a greater amount of heat is supplied to the connector, thus assuring more thorough soldering, a set-up which results in much faster soldering operations. This method of heating connectors is used by Westinghouse.



SET-UP to heat large connectors for soldering by use of a welding transformer

•

Graphic Analysis of Accident Record

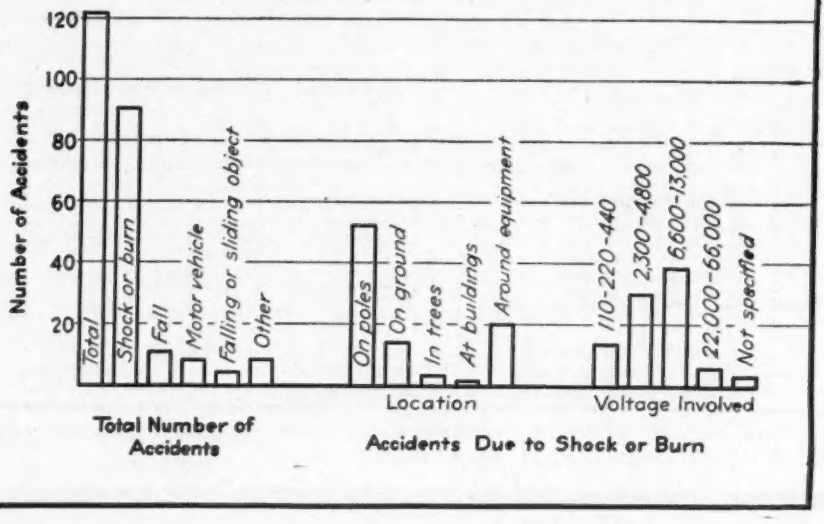
All safety departments have received the report of the accident prevention committee of the Edison Electric Institute, tabulating the 121 fatal accidents attributable to electrical causes. "We wish that every man in our operating department could be induced to memorize the whole list," says J. E. Yates, safety supervisor of the Pacific Power & Light Company, Portland, Ore., "though obviously that would be next to impossible of accomplishment. I have, therefore, sought to visualize this record to them in a way that would impress upon them certain fundamentals embodied in these findings as relating to their own interests.

"To do this, and I have found it very effective in my work, I have broken down the 121 accidents and put the result of my analysis in the form of a chart, which shows (1) the kinds of accidents in five general classifications. Of these, approximately 70 percent were due to shock or burn. However, falls, falling objects, vehicle accidents and miscellaneous, directly connected with some electrical job in hand, are by no means insignificant in number and must be constantly guarded against.

"The accidents attributable to burn or shock are then further broken down as to (2) location and (3) voltage involved. Here again there are certain prime offenders along with certain other minor though important sources of danger. For instance, take deaths due to low-voltage contacts. These account for approximately 14 percent of all deaths due to burn or shock. Yet, unless this fact can be forcibly brought home, visualized and remembered, there will continue to be more or less disregard of the fatal possibilities that are present in the lower voltage circuits.

"By using the chart in my group and individual talks I find that I can 'get across' the very significant message embodied in the committee's valuable tabulation."

BREAKDOWN of E.E.I. accident prevention committee's tabulation of 121 fatal accidents into times, places and voltages



CONDUCTOR SIZES FOR DISTRIBUTION SECONDARIES

By PHILIP MORRILL, Designer, Stone & Webster Engineering Corporation, Boston

Size of Secondary Copper Conductor on Racks

For 240-volt, single-phase, two-wire or 240/120-volt, single-phase, three-wire circuits. 60 cycles, 90 percent power factor and 8 in. rack space

Load, Kw.	Distance, Feet (One Way)																				Volt. Drop, %
	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	
	Conductor Size, AWG or MCM																				
2.5	....	....	....	....	....	....	....	....	8	7	6	5	5	4	4	4	3	3	3	3	1
	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8	7	7	7	6	2
	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8	3
5	....	....	....	8	6	5	4	4	3	3	2	2	1	1	1/0	1/0	2/0	2/0	2/0	2/0	1
	....	....	....	....	....	....	....	8	7	6	5	5	5	4	4	4	3	3	2	2	2
	....	....	....	....	....	....	....	....	....	....	....	....	8	6	6	6	5	5	5	4	3
7.5	....	....	8	5	4	3	2	2	1	1/0	1/0	2/0	2/0	3/0	3/0	4/0	4/0	250	250	300	1
	....	....	....	....	8	7	6	5	4	4	3	3	2	2	2	2	1	1	1/0	1/0	2
	....	....	....	....	....	....	....	8	6	6	6	5	5	4	4	4	3	3	3	3	3
10	....	8	5	4	3	2	1	1/0	2/0	2/0	3/0	4/0	4/0	250	300	300	350	350	400	400	1
	....	....	8	8	6	5	4	4	3	2	2	2	1	1	1/0	1/0	2/0	2/0	2/0	2/0	2
	....	....	....	....	....	8	6	6	5	5	4	4	3	3	3	2	2	2	1	1	3
12.5	8	6	4	3	1	1/0	2/0	2/0	3/0	4/0	250	300	350	350	400	400	450	500	500	...	1
	....	....	8	6	5	4	3	2	2	1	1	1/0	1/0	2/0	2/0	2/0	3/0	3/0	4/0	4/0	2
	....	....	....	....	8	6	5	5	4	4	3	3	2	2	1	1	1	1/0	1/0	1/0	3
15.0	6	5	3	2	1/0	2/0	3/0	4/0	250	300	350	350	400	450	500	500	...	...	...	...	1
	7	7	6	5	4	3	2	2	1	1/0	1/0	2/0	2/0	3/0	3/0	4/0	4/0	250	250	300	2
	7	7	7	7	6	5	5	4	3	3	2	2	1	1	1/0	1/0	2/0	2/0	2/0	2/0	3
17.5	5	4	2	1	2/0	3/0	4/0	250	300	350	400	450	500	...	...	...	...	...	...	...	1
	6	6	6	4	3	2	1	1	1/0	2/0	2/0	3/0	3/0	4/0	4/0	250	300	300	350	350	2
	6	6	6	6	5	4	4	3	2	2	1	1	1/0	1/0	1/0	2/0	2/0	2/0	3/0	3/0	3
20.0	5	4	2	1/0	3/0	4/0	250	300	350	400	450	500	...	...	...	...	...	...	...	...	1
	5	5	5	4	2	2	1	1/0	2/0	2/0	3/0	4/0	4/0	250	300	300	350	350	350	400	2
	5	5	5	5	5	4	3	2	2	1	1/0	1/0	2/0	2/0	2/0	3/0	3/0	4/0	4/0	4/0	3
22.5	4	3	1	2/0	3/0	300	300	350	400	500	...	...	...	...	...	...	...	...	...	...	1
	4	4	4	3	2	1	1/0	2/0	3/0	3/0	4/0	250	300	300	350	350	350	400	400	450	2
	4	4	4	4	4	4	3	2	1	1/0	1/0	2/0	2/0	3/0	3/0	4/0	4/0	4/0	4/0	4/0	3
25.0	4	3	1/0	2/0	4/0	300	350	400	500	...	...	...	...	...	...	...	...	...	...	...	1
	4	4	4	2	1	1/0	2/0	2/0	3/0	4/0	250	300	350	350	350	400	400	450	500	500	2
	4	4	4	4	4	3	2	1	1/0	1/0	2/0	2/0	3/0	3/0	4/0	4/0	250	250	250	250	3
27.5	3	2	1/0	3/0	250	350	400	450	...	...	...	...	...	...	...	...	...	...	...	...	1
	3	3	3	2	1	1/0	2/0	3/0	4/0	250	300	350	350	350	400	450	450	500	...	...	2
	3	3	3	3	3	2	1	1/0	1/0	2/0	2/0	3/0	4/0	4/0	4/0	250	250	250	250	300	3
30.0	2	2	2/0	250	300	350	500	500	...	...	...	...	...	...	...	...	...	...	...	...	1
	2	2	2	2	1/0	2/0	3/0	4/0	250	300	350	350	400	400	450	500	500	...	...	...	2
	2	2	2	2	2	2	1	1/0	2/0	2/0	3/0	3/0	4/0	250	250	250	250	300	300	300	3
32.5	2	1	2/0	250	350	400	500	....	....	....	....	....	....	....	....	....	....	....	....	....	1
	2	2	2	1	1/0	2/0	3/0	4/0	300	300	350	350	400	450	500	....	....	....	....	....	2
	2	2	2	2	2	1	1/0	2/0	2/0	3/0	4/0	4/0	250	250	250	250	300	350	350	400	3
35.0	1	1	3/0	250	350	450	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
	1	1	1	1	2/0	3/0	4/0	250	300	350	350	400	450	500	....	....	....	....	....	....	2
	1	1	1	1	1	1	1/0	2/0	3/0	4/0	4/0	250	250	250	250	300	350	400	400	450	3
37.5	1	1/0	3/0	300	400	500	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
	1	1	1	1/0	2/0	3/0	4/0	300	350	350	400	450	500	....	....	....	....	....	....	....	2
	1	1	1	1	1	1/0	2/0	2/0	3/0	4/0	250	250	250	300	300	350	400	400	450	500	3
40.0	1/0	1/0	4/0	300	400	500	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
	1/0	1/0	1/0	1/0	2/0	4/0	250	300	350	400	450	500	....	....	....	....	....	....	....	....	2
	1/0	1/0	1/0	1/0	1/0	1/0	2/0	3/0	4/0	4/0	250	250	250	300	350	400	400	450	500	500	3
42.5	1/0	2/0	4/0	350	450	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
	1/0	1/0	1/0	2/0	3/0	4/0	300	350	350	400	450	500	....	....	....	....	....	....	....	....	2
	1/0	1/0	1/0	1/0	1/0	2/0	2/0	3/0	4/0	250	250	250	300	350	400	400	450	500	....	....	3
45.0	2/0	2/0	250	350	500	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
	2/0	2/0	2/0	2/0	4/0	250	300	350	400	450	500	....	....	....	....	....	....	....	....	....	2
	2/0	2/0	2/0	2/0	2/0	2/0	3/0	4/0	250	250	250	300	350	400	400	450	500	....	....	....	3

NOTE.—Wire sizes in italics, *e.g. 6*, are minimum required for current, TBWP, 30 deg. rise, 30 deg. C ambient, outdoor.

Accompanying table has been developed for selecting single-phase secondary copper conductor sizes for various loads, distances and voltage drop. In many of the present-day layouts, due to copper shortage, a 3 percent drop is allowable in secondary runs from transformer to point of service entrance. In standard work a 1 or 2 percent limit gives better voltage regulation.

Neutral wire for loads given should equal line wire. For load exceeding 200 amp. 120 volts wire size may be reduced by 30 percent for that part of the load exceeding 200 amp. provided the load is made up of small units; *i.e.*, no large motor constitutes a sizable portion of total load. However, as most systems today have common neutral with primary, it is considered good practice to keep the neutral to line size to insure a ground return that will not burn out.

Conversion factors for values not directly covered by the table:

Voltage and Phase	Factor
240 volt, 3 phase	2
440 volt, 3 phase	8
440 volt, 1 phase	4
208 volt, 3 phase, 3 or 4 wire	1.5
120 volt, 1 phase	0.25
120 volt, 3 phase	0.5

To use factor divide load by factor and new value found is used on chart with actual distance and drop to determine wire size.

Example—20 kw. at 200 ft. 2 percent drop, 240-volt, 3-phase, 90 percent power factor. Then $20/2 = 10$. For 10 kw. on chart at 200 ft. use No. 4 wire.

Power Factor—Multiply actual kw. by ratio of 90 percent power factor of chart to actual power factor to determine kw. to be used on chart.

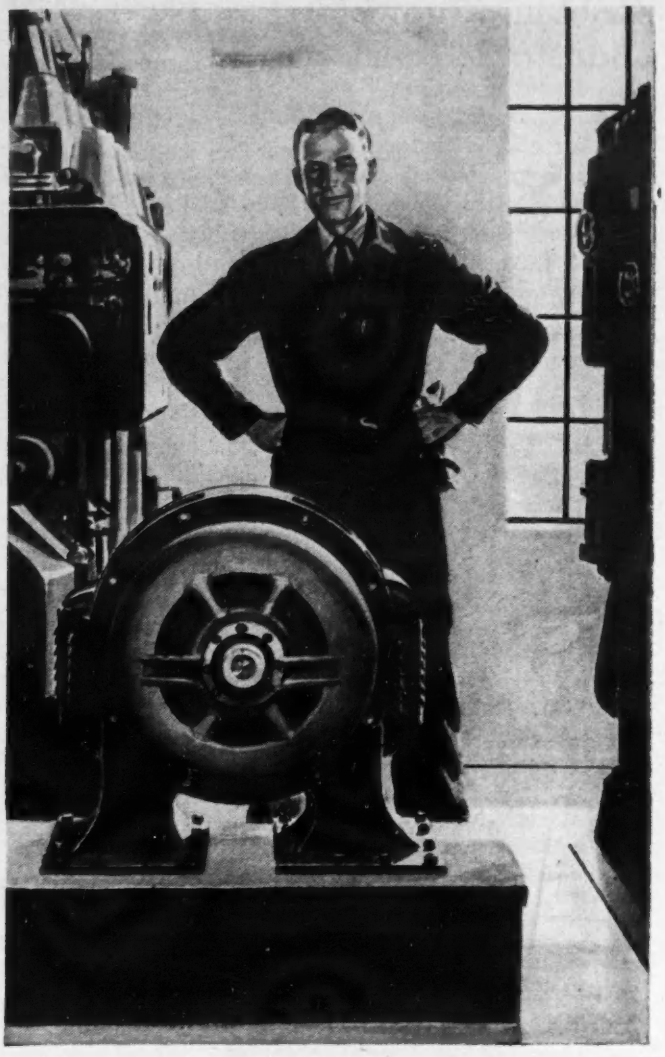
Example—20 kw. at 240 volts, 1-phase, 80 percent power factor, 2 percent drop, 200 ft. Then $20 \times 90/80 = 22.5$ kw. For 22.5 kw. at 200 ft. 2 percent drop use No. 2/0 wire.

Drop—Actual load divided by ratio of actual drop to drop taken from table gives new load to be used. Read on same drop as used on table.

Example—10 kw. at 200 ft., 90 percent power factor, 240 volts, 1-phase, 4 percent drop. Then $10 \div 4/2 = 5$ kw. For 5 kw. at 200 ft., 2 percent drop use wire size No. 8.

Spacing—Table covers standard 8 in. spacing as used on racks. However, spacing of 7 to 12 in. will vary but little from these values. Conduit spacing will reduce wire size appreciably and other tables should be used. Likewise wide spacing would increase wire size required.

In some cases on short runs the wire size required for a given drop will be found less than that required to carry the current. In these cases the table has been corrected by inserting larger size wire. These sizes are in *italics*. If table is used for 440 volts, 3-phase, care should be used where size falls on value in *italics*, as larger wire may be required for current than given by this table.



Why do these problems have a single solution?

260 feet down in icy water, a diver must be protected from paralyzing cold, terrific pressure . . . and the possibility of fire.

To help him endure the pressure, he is supplied with an oxygen-helium atmosphere. To protect him from the cold, he often wears an electrically heated suit.

If the heating wires which keep him warm become exposed or broken, arcing might occur which would ignite any of the combustible material inside the suit . . . burn the diver to a crisp. To guard against this possibility, the heating wires of his suit are protected by layers of Fiberglas* cloth.

This material is fire-and-heat resistant —its individual fibers are made of glass and cannot burn. This is another way of saying that Fiberglas withstands "excessive temperature rises."

And from this point of view, the Fiberglas lining in the diving suit and the Fiberglas component in electrical insulation have much in common. For instance:

In electric motors, generators, and transformers, Fiberglas insulation is capable of withstanding the high temperatures caused by today's severe overloading. Properly impregnated, Fiberglas electrical insulation is also highly resistant to moisture and corrosive vapors. Having a low space factor, Fiberglas can readily be used for rewinding armatures originally class "A" insulated. Also, this feature often permits the redesign and building of smaller-sized, more compact units.

These and other qualities of Fiberglas Electrical Insulation are being used to their best advantage by the Army and Navy for many types of motors, generators, wiring and cable in planes, tanks and ships.

As the production of Fiberglas is being constantly increased, so more and more of this material is becoming available for more applications.

Ask your electrical distributor for technical data on Fiberglas and about its availability for your use. Or write:

Owens-Corning Fiberglas Corporation, Toledo, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.

ARMY E NAVY

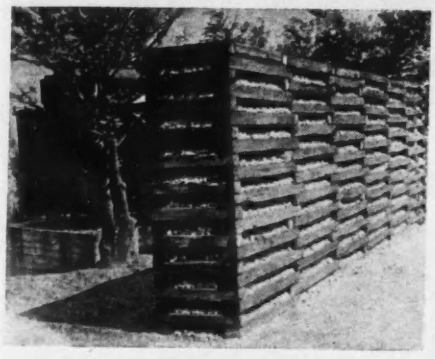
FIBERGLAS

*T. M. Reg. U.S. Pat. Off.

ELECTRICAL INSULATIONS

Cribbing Guard for Industrial Transformers

Protection of transformers against rifle fire and bomb fragments is economically provided in an Eastern industrial plant by stone-filled cribbing composed of old railroad ties (8 ft. 6 in. x 8 in. x 6 in.) framed together by ¾-in. vertical driftpins, using two



STONE-FILLED STRUCTURE utilizes old ties and insures good drainage with shock-absorbing material

pins at each tie end interlocking in the main structure. Cinder blocks were originally considered, but these did not resist explosive forces on test. In a typical installation protecting two 5,000-kva. Warren three-phase transformers the cribbing was built with a 15-ft. 6-in. x 22-ft. 4-in. base and was made 4 ft. 3 in. wide over all and 12 ft. 6 in. high. A 3-ft. air space was left between the crib and the transformers. The stone filling was crushed to 2-in. maximum diameter.

•

Battery Stabilizer Excitation System

By C. O. von DANNENBERG
Brooklyn, N. Y.

The sudden addition to a system of more than 300 miles of 66-kv. circuit, with a leading reactive load exceeding 8,000 kva. and the actual kw. load small, gave rise to a condition in the generator excitation resulting in unstable operation.

When the additional circuit mileage was connected the automatic voltage regulator reduced the exciter volts from 250 to 90 and remained between 90 and 100 volts during the operating period. The generating unit had a direct-connected exciter but no main generator field rheostat, hence the self-excitation due to the line characteristic had to be controlled directly by varying the exciter field, which in turn reduced its value to an unstable point. The operating result was that any line disturbance virtually "killed" the excitation system, with an attendant interruption to service.

Since immediate action was necessary to rectify the condition and the remoteness of the station and lack of funds were contributing elements to simple and direct improvement, all obvious and possible methods were considered, including even the addition of a fixed resistor in the main generator field which would require the exciter to operate at a higher voltage.

The final method used was the connection of the exciter field to the station control battery. This arrangement provided a definite positive source of excitation independent of outside influences electrically or system conditions; the added drain to the battery of less than one ampere was negligible in its total load.

Resulting operation was satisfactory and involved no undue expense or the purchase of new equipment.

It should be stated that the generating equipment when initially furnished did not anticipate such extreme conditions, virtually those referred to in textbooks where extreme leading power-factor load conditions were the rule throughout the operating period. It is clear that a unit now supplied for such an application would include a pilot exciter for providing the main exciter field with an unfailing and unvarying source of excitation.

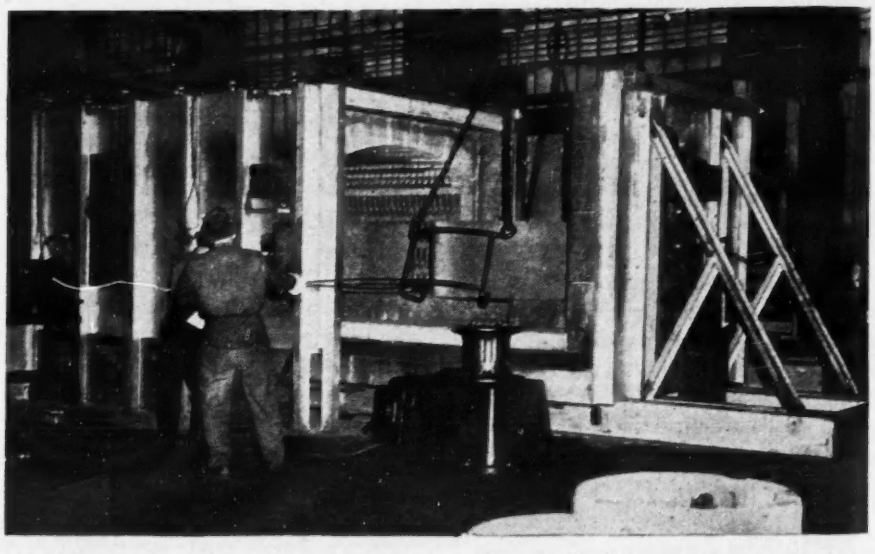
The method described is not in any sense an essentially new one, but it does embody certain essential features common to a high-speed excitation system; when it was applied such systems were not in extensive use.

•

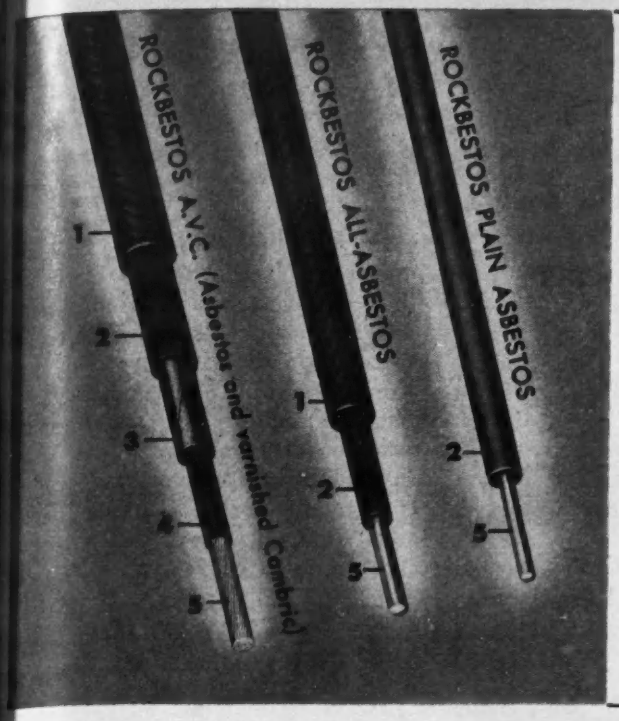
Forgings Moved in One-Half Time

By presetting the position of the lifting hooks and placing the quenching tank so that it is reached with but a small amount of straight-line travel steel rings and other forgings are quenched in 25 seconds after the furnace doors are opened in the heat-treating department at General Electric's Schenectady Works. The new handling method halves the time formerly required and obtains better results from the heat-treating process inasmuch as heat loss is negligible.

Special double hooks suspended from a crane on self-equalizing chains are held apart by operators with tongs on both sides of the car-type furnace when it is ready to be opened. The hooks are suspended at a height which will just allow them to clear the bottom of the ring when allowed to move in. With the hooks quickly positioned, the craneman lifts the ring just enough to clear the supports on which it was set and moves it straight across and into the quenching tank, located only about 15 ft. from the side of the furnace. The quenching tank is lower than the furnace platform, further minimizing crane movement.



FURNACE PLATFORM is rolled out, hooks are allowed to swing into position and forgings are moved in half of former time from furnace to quenching tank shown at lower left corner



3 GETS YOU 122

122 wires, cables and cords, stemming from the three basic designs illustrated, have been developed by Rockbestos to give trouble-free performance under severe operating conditions in steel mills, power plants, chemical industries, etc. Send for catalog to see the rest.

Rockbestos Permanent Insulation Insures Long-Lived Performance

1. A tough, rugged asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.
2. Felted asbestos insulation impregnated with heat-, flame-, and moisture-resisting compounds will not dry out, become hard and brittle, or burn. Also serves as a heat-barrier against high ambient temperatures.
3. Lubricated varnished cambric for high-dielectric strength and added moisture resistance, protected from heat, flame, and oxidation by felted asbestos walls.
4. Felted asbestos insulation that withstands conductor-heating overloads and won't burn even when exposed to copper-melting arcs.
5. The conductor is perfectly centered in helically applied insulation and will always remain so.

600 VOLT A.V.C. SWITCHBOARD WIRE—TABLE B
(Underwriters' Type AVB)

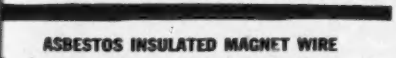
Sizes No. 18 to 4/0 A. W. G. with varnished cambric and felted asbestos insulation and gray, black, white or colored flameproof cotton braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is absolutely fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A. V. C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heatproof characteristics.

INDUSTRIAL HEATING CABLE—TABLE LH

No. 19 A. W. G. nickel-chromium wire insulated with 3/64" of felted asbestos and covered with 4/64" waterproof lead sheath.

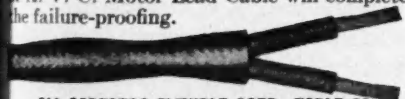
This pliable cable distributes a mild heat evenly over a large area. Prevents freezing of water pipes, wet pipe sprinkler systems, etc. Keeps conveyor pipes for fuel oil, soap, varnish, ink, chocolate, etc., at temperatures that insure steady flow.



ASBESTOS INSULATED MAGNET WIRE

Round, square and rectangular asbestos insulated conductors finished to meet varying winding conditions and coil treatment requirements.

Protect your motors against heat-induced breakdowns with class B windings of Rockbestos Heat-Resisting Magnet Wire. Leads of A. V. C. Motor Lead Cable will complete the failure-proofing.



ALL-ASBESTOS FLEXIBLE CORD—TABLE CA

Sizes No. 10 to 18 A. W. G. with two or three conductors insulated with felted asbestos, covered with asbestos braid. Also in A. V. C. (asbestos and varnished cambric) constructions.

This heat-resisting flexible cord is ideal for high-wattage lighting units, floodlights, blueprint machines, apparatus, etc., which require a heavy duty, enduring cord. For moisture-resistant construction specify the A. V. C. type. Labeled cord with polarized conductors if desired.

600 VOLT A.V.C. BOILER ROOM WIRE—TABLE C
(Underwriters' Type AVA)

Sizes No. 18 to 4/0 A. W. G. This construction for sizes 18 to 8, sizes 6 to 4/0 have another wall of felted asbestos next to the conductor.

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A. V. C. construction is ideal. Also for locomotive panel wiring and for switchboards requiring an asbestos braided wire.

THERMOSTAT CONTROL WIRE—TABLE TC

Sizes No. 14, 16 and 18 A. W. G. in two to six conductors with 12½, 25 or 31 mil wall of felted asbestos insulation and cadmium plated steel armor.

A multi-conductor control wire for low voltage intercommunicating, signal and temperature control systems. Its lifetime insulation and rugged steel armor will give you trouble-proof circuits.

600 VOLT ALL-ASBESTOS RHEOSTAT CABLE—TABLE R
(Underwriters' Type AI)

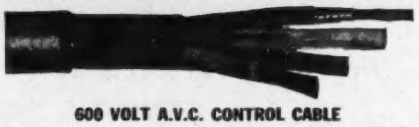
Sizes No. 18 A. W. G. to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For solid conductor specify Rockbestos Rheostat Wire, Table A.

600 VOLT A.V.C. MOTOR LEAD CABLE—TABLE L
(Underwriters' Type AVA)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with two walls of felted asbestos and a high-dielectric, heat-sealed varnished cambric insert, covered with heavy asbestos braid.

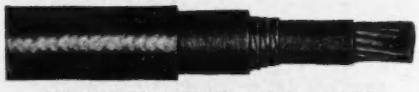
Heatproof, fireproof, greaseproof and oilproof, will not dry out and crack, won't burn or carry flame, and remains permanently flexible. For coil connections, motor and transformer leads where extreme heat and fire hazards are encountered as in steel mills, etc.



600 VOLT A.V.C. CONTROL CABLE

In one to 19 conductors. Standard stranding A. W. G. No. 12—19/No. 25 and No. 9—19/No. 22. Other strandings furnished.

Designed for use under conditions too severe for control cables with other types of insulation which deteriorate rapidly when exposed to high temperatures. Operates without failure under the attack of heat, oil, grease or corrosive fumes and may be installed in conduit as it has ample moisture resistance.



600 VOLT A.V.C. POWER CABLE—TABLE E
(Underwriters' Type AVA)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with laminated felted asbestos, varnished cambric, and asbestos braid. Other constructions for service voltages to 8000.

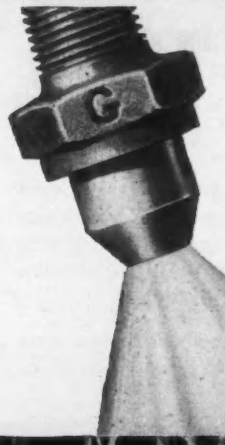
Recommended for power circuits and hot spot wiring in or around boiler rooms, steam tunnels, soaking pits, tenter frames, glass plants, etc. The asbestos and heat-sealed varnished cambric construction has ample moisture resistance and withstands high temperatures.

Rockbestos Products Corporation, 914 Nicoll Street, New Haven 4, Conn.

WON'T bake brittle, bloom, burn or rot—RESISTS heat, moisture, oil, grease and fumes

ROCKBESTOS

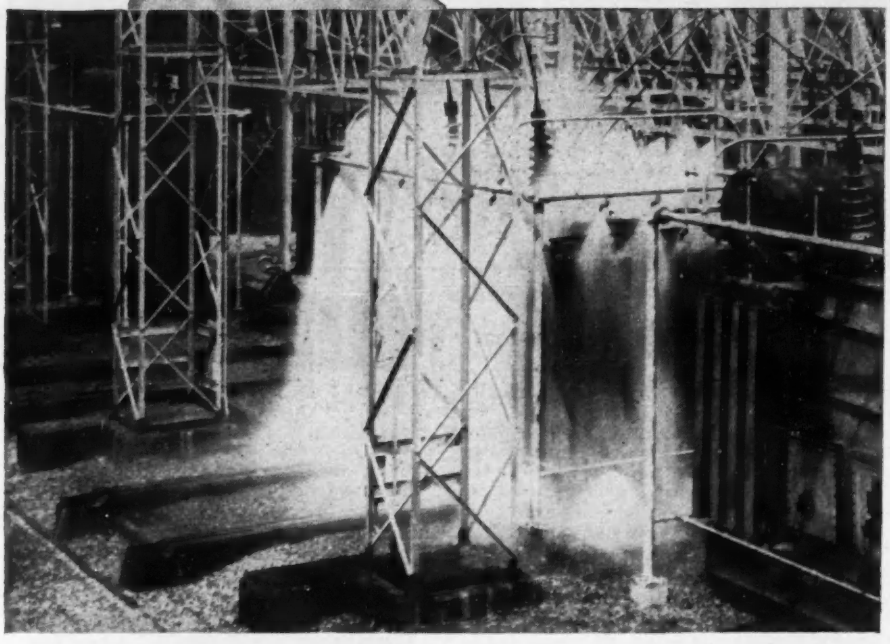
The Wire with Permanent Insulation



How to prevent

"ABSENTEEISM"

of Power-Producing Equipment



Protect your oil-filled equipment from FIRE with a GRINNELL MULSIFYRE SYSTEM

MULSIFYRE SYSTEMS operate on the principle of mulsifying blazing oil with a driving spray of water. The oil is turned into a liquid which is incapable of burning. A Mulsifyre System extinguishes fire in a few seconds and prevents reignition.

Complete separation of water and oil takes place in a few hours . . . leaves oil undamaged.

There is absolutely no conductivity along the discharge of a Mulsifyre projector when spray strikes conductors carrying high voltages.

Mulsifyre Systems are permanently installed . . . they operate automatically and manually.

Recommended by Underwriters' Laboratories for use in extinguishing fires in flammable oils immiscible with water, wherever such oil is a fire hazard . . . in transformers and other oil-filled electrical equipment.

Investigate this simple, sure oil fire protection. Write for Data Book by Underwriters' Laboratories. Grinnell Company, Inc., Executive Offices, Providence, Rhode Island. Branch offices in principal cities of U. S. and Canada.

GRINNELL

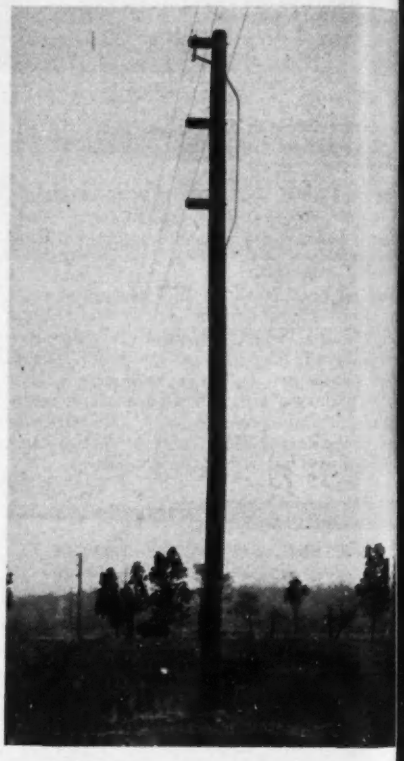
MULSIFYRE SYSTEMS

For Production Protection

Post Units, No Arms, Narrow Right-of-Way

By GODFREY MORGAN, Jr.,
Assistant Engineer Public Service Electric & Gas Company, Newark, N. J.

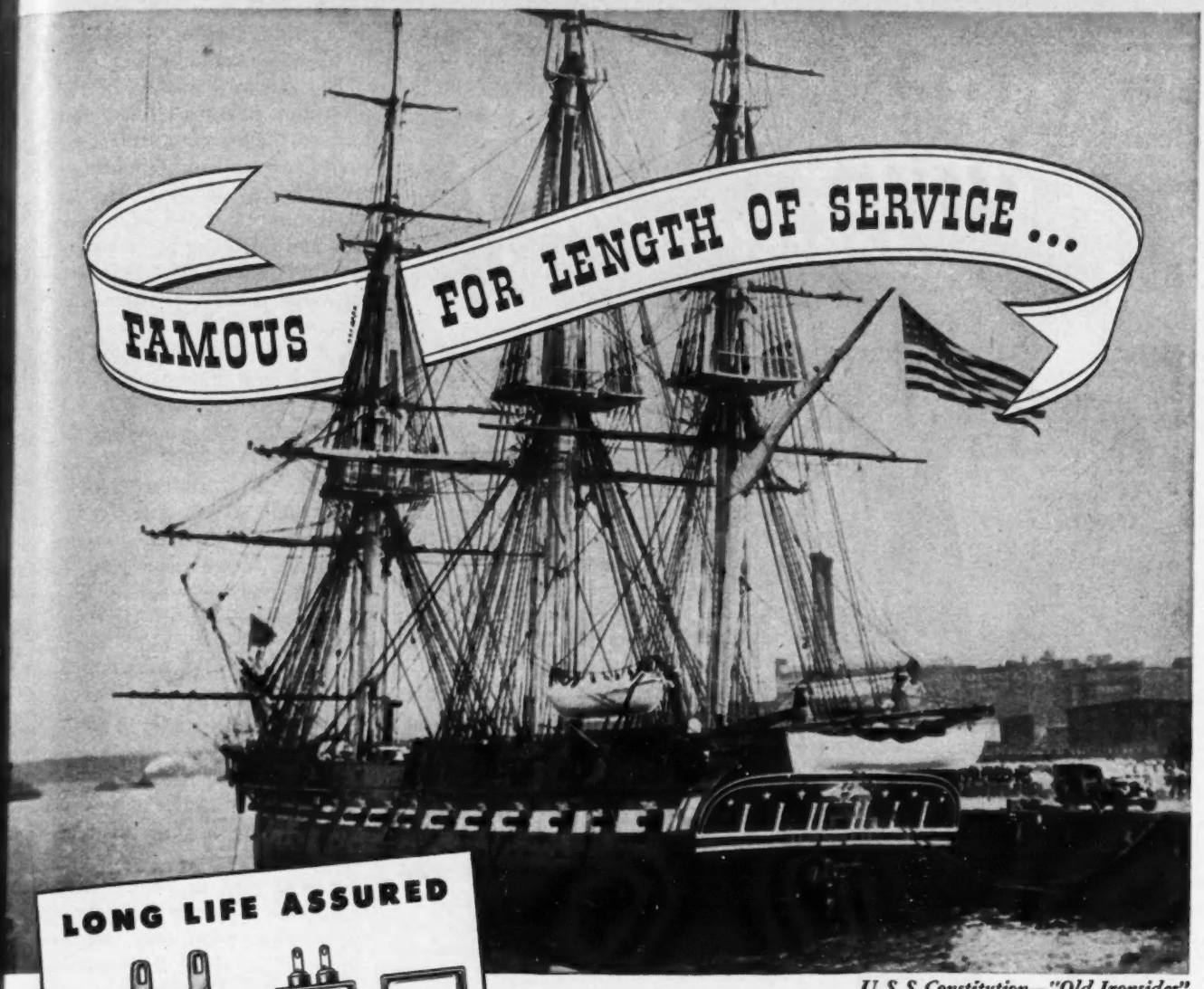
In providing service to a new customer the Public Service Electric & Gas Company was confronted with two alternate routes, one which would permit standard construction over rural highways, with the usual turns and the necessity for tree trimming, and another more direct route, over a narrow private right-of-way occupied by the customer's buried pipe line. It was apparent at once that a vertical configuration of conductors for the



CROSSARMLESS LINE erected on a narrow right-of-way

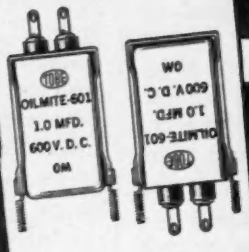
26-kv. line would be the only practical method of utilizing the narrow right-of-way, which is 4 miles long.

While the No. 6 Amerductor which was selected would permit long spans, particularly with the low ground clearance required for a private right-of-way, the maintenance of clearances under wind loading dictated the use of relatively short spans (400 ft.) and the use of 40-ft. poles. This permitted the use of line post insulators mounted horizontally on the poles at 4-ft. spacing, even though designed for heavy loading. Special ties were used to re



U. S. S. Constitution—"Old Ironsides"

LONG LIFE ASSURED



The new separate mounting is stronger and prevents oil leaks caused by breaks in can. This modern design takes the minimum of space.

TYPE	OM
RATINGS	.05 to 2.0 mfd. 600 V.D.C. .05 mfd. to 1.0 mfd. 1,000 V.D.C.
STANDARD CAPACITY TOLERANCE.	±10%
TEST VOLTAGE	Twice D.C. rating
GROUND TEST	2,500 Volts, D.C.
SHUNT RESISTANCE	.05 to 0.1 mfd. 20,000 megohms. .25 to 0.5 mfd. 12,000 megohms. 1.0 to 2.0 mfd. 12,000 megohms.
POWER FACTOR	At 1,000 cycles—.002 to .005
CONTAINER SIZE	Width ⅝", length 1-5/16", height 2¼"
MOUNTING HOLE CENTERS	1½"

YOU WANT capacitors that can stand up and take it. The well-nigh flawless record of Tobe Capacitors as to "returns" proves they have that outstanding requirement of durability.

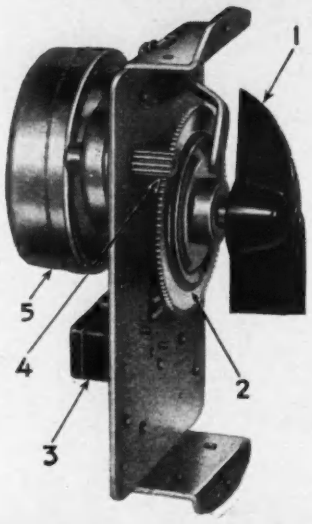
This quality is built into each and every Tobe Capacitor by advanced engineering practices and production methods. And their rating is always an "understatement".

Shown here is the Tobe Oilmite Capacitor. Filled and impregnated with mineral oil it is used as a filter condenser in war equipment. The new hold-down bracket permits inverted or upright terminals, with wiring either underneath or on top of chassis.

TOBE DEUTSCHMANN CORP.
TOBE
CANTON · MASSACHUSETTS

A SMALL PART IN VICTORY TODAY—A BIG PART IN INDUSTRY TOMORROW

Another Paragon Timer achievement!



Here's a notable development in automatic electric timers . . . which includes several distinct engineering and operating improvements.

ENGINEERING FEATURES

1 The setting knob is directly connected thru the switch operating cam; unit does *not* set thru a clutch; this provides positive switch action.

2 All energy required to operate switch itself is built up by manually setting pointer. Motor and clutch thereby relieved of all drag.

3 Switch—single pole, double throw, 1000 watt capacity, fully enclosed. Underwriter's approved.

4 Only 2 exposed gears—motor pinion and wheel. Precision hobbed.

5 Motor—self starting, slow speed, industrial type synchronous, completely sealed.

6 No energy is required of clock motor to trip switch at end of present time.

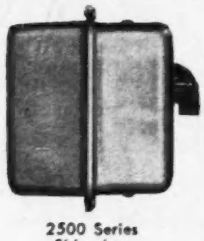
7 Nine time ranges from 0 to 14¼ seconds through 0 to 9¼ hours. Available in all types of enclosures.

8 All parts rust proofed and protected against corrosion.

2400 Series
For flush mounting

2900 Series
Wall mounting

2500 Series
Enclosed type



2500 Series
Side view
Mounts on handy boxes

NUMEROUS APPLICATIONS

Adaptable to any manually preset application with automatic switch operation at end of time cycle, such as plastic molding, rubber curing, batch mixing, heat treating, enamel baking, liquid agitation, light exposure—photographic, therapeutic, blue printing, infra-red drying,— blower operation, pump operation, conveyor operation and food processing.

PRECISION BUILT: This and every other Paragon unit is precision built, simple, accurate, reliable, modern and reasonably priced. Made by an organization of designers and engineers, growing since 1905.

SEND FOR BULLETIN . . . ***containing complete construction and installation data.***

PARAGON ELECTRIC COMPANY
407 S. DEARBORN ST. • CHICAGO 5, ILL.

Paragon *Chicago*
BUILDERS OF ELECTRICAL EQUIPMENT . . . SINCE 1905

duce fatigue stresses, as recommended by the wire manufacturer.

The standard method of lightning protection in use by this company is to make the top conductor a shielding conductor drained by lighting protector tubes, as described in "Lighting Protection of Wood Pole Lines" by Sels and Gothberg in *Electrical Engineering*, June, 1940. This protection appeared particularly necessary for a customer served by a single feed of small wire to lessen the likelihood of tripouts and burndowns. The customer permitted welding of lugs to his pipe line for grounding, thus providing an unusually low ground resistance. By installing protection at every pole it was possible to secure adequate clearance between the grounded down lead and the ungrounded phase wires by the use of the clearance strap developed for standard construction. The accompanying illustration shows the line equipment arrangement.

The economy achieved by the cross-armless line has been so good that variations have been used on subsequent lines. Obsolete corner pins were adapted to permit use of standard pin type insulators, and a wooden outrigger was used to secure the greater clearance required for the ground wire when the ground resistance was high. This type of construction is suitable for comparatively long spans with the sizes of wire to which we are now restricted for small and moderate loads, but should not be used for larger wires without a very careful check of the insulator stresses involved in horizontal mounting.

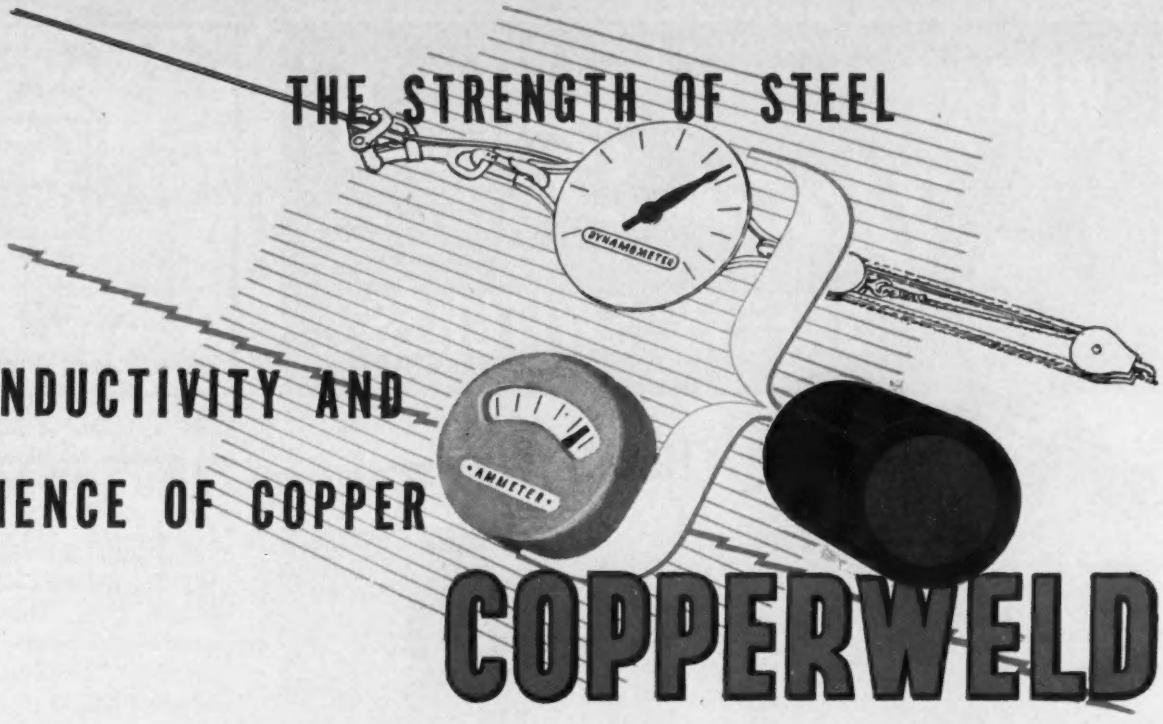
•

Stops Emulsification of Bearing Oil

A small sump added to the bottom of the water-jacketed bearing housing of a 3,600-r.p.m., 1,200-psi., six-stage boiler feed pump at Ohio River station, Southern Indiana Gas & Electric Company, has prevented recurrence of bearing failure caused by emulsification of the lubricating oil by condensed moisture. The sump provides a well into which the moisture can settle and be drained off, where formerly it was churned into the oil by the action of the bearing.

During the course of normal breathing air and moisture were

THE STRENGTH OF STEEL

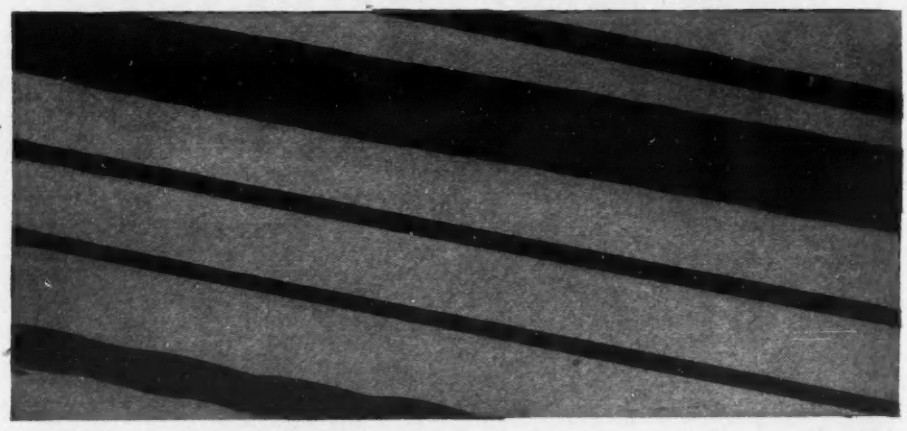


THE CONDUCTIVITY AND PERMANENCE OF COPPER

COPPERWELD

Copperweld wire derives its strength from its core of strong steel—steel permanently protected against rusting by a thick exterior of copper. The copper need only do the job that copper does best—provide *rust resistance and electrical conductivity*. The steel need only do the job that steel does best—*provide strength*. No other wire combines the strength of steel with the conductivity and permanence of copper.

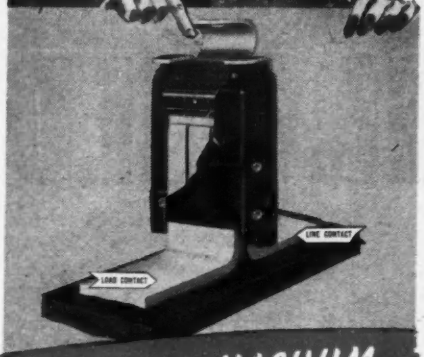
Copperweld Steel Company GLASSPORT, PA.



Millions of pounds of Copperweld wire are used for communications on all our battlefronts.

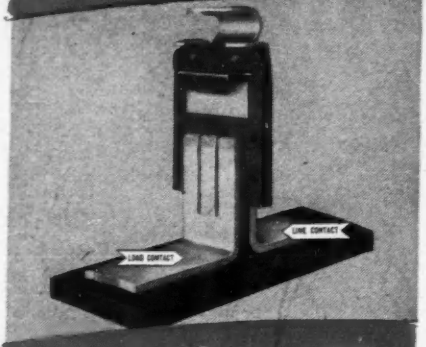
WHY Vacu-Break SAFETY SWITCHES?

Here's Why—

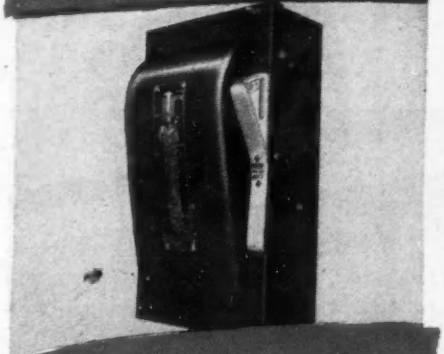


PARTIAL VACUUM quickly smothers arcs

CONTACTS (IN ON POSITION) tight as a bolted connection



CONTACTS MAKE AND BREAK with automatic ease



PUSH-TYPE, FRONT-OPERATED rocker handles enhance the fine effect of streamlined switch cabinets.

BullDog's Clampmatic Vacu-Break design combines in a simple construction the two features most essential to flawless safety switch performance — *clamp-tight contacts* and *easy operation.*

It is worth remembering that BullDog — with all its advantages of simplicity, fine appearance and positive action — costs no more than switches *without* this thoroughly modern design.

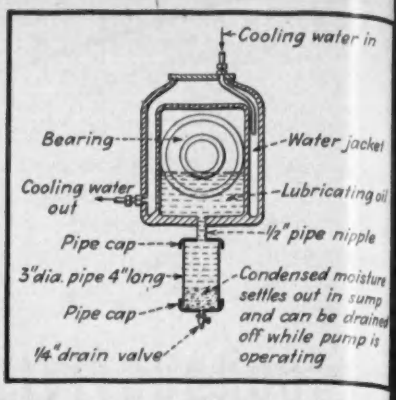
Ask your BullDog field engineer to give you his interesting mechanical demonstration of the Clampmatic Vacu-Break principle.

BULLDOG ELECTRIC PRODUCTS CO.
Detroit, Michigan
BullDog Electric Products of Canada, Ltd., Toronto, Ontario
Field Engineering Offices in All Principal Cities

MANUFACTURERS OF a complete line of Vacu-Break Safety Switches, Panelboards, Switchboards, Circuit Master Circuit Breakers and BUStribution SYSTEMS.

• • •

For a bright future BUY MORE WAR BONDS



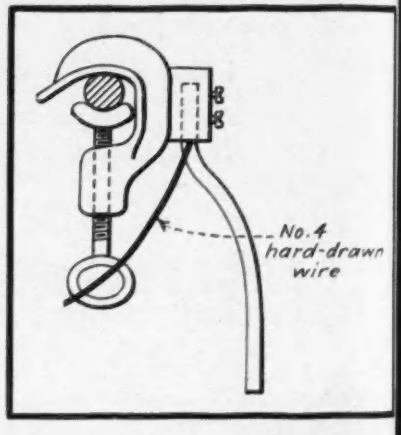
SUMP at bottom of bearing housing collects moisture condensed by cold bearing water jacket

drawn into the bearing housing where it condenses on the cool water-jacketed walls. Until the sump was provided this water became mixed with the oil, causing emulsification and eventual failure of the bearing.

The sump, made from a 4-in. length of 3-in. pipe, is shown connected to the bottom of the bearing housing by a ½-in. pipe nipple. The sump provides a well into which the moisture can settle and be removed through the drain valve provided for the purpose.

•

Stops Radio Interference



Radio interference caused by loose hot-tap clamps on the system of the Kansas Gas & Electric Company, Wichita, has been corrected by the simple expedient of installing a short piece of No. 4 hard-drawn wire in the conductor socket, as shown, and bending it to pass through the eye of the threaded member. Stiffeners of the short length of wire is sufficient to keep the threaded member from turning under the effect of conductor vibration.

War Production Board Limitation Order L-154 Schedule V

W.P.B. has ruled that

The Brewer-Titchener Corporation, as prime manufacturer, having existing dies, tools, and equipment for producing Forged Steel Transmission Clamps, Strain Yoke Sets, and Hardware, but without equipment or facilities for the manufacture of similar products in other materials or by other processes, may continue to offer, sell, and produce such materials.

Therefore

You may continue to order B.T.C. Hi-Line Clamps and Fittings through your insulator manufacturer.

Through Your Insulator Manufacturer Only

BTC

THE BREWER-TITCHENER CORPORATION – CORTLAND, NEW YORK

LOAD SERVICING

Industrial • Commercial • Rural • Residential

Electric Service Aids Cartridge Die Plant

On the site of the old Middlesex Tavern in Lowell, Mass., where the Marquis de Lafayette once spent a night, a converted blacksmith and wheelwright shop is now producing some 7,000 dies a month used in the manufacture elsewhere of copper cartridge cases, mainly of 30 and 45 caliber. Under the name Middlesex Village Tool Company, the establishment keeps about 30 employees busy on a production basis of some 5,000 man-hours per month, and its 30 motors used in miscellaneous individual and group drives consumed an average of 1,358 kw.-hr. per month in a recent five-month run. During that period the lighting requirements averaged 496 kw.-hr. per month. Demand on the power circuits was 9 kw., and 3.1 kw. for lighting. On the above basis the energy consumption per 100 dies averaged 19.4 kw.-hr. for power and 7.1 kw.-hr. per 100 dies for lighting.

The main shop is only 50 ft. long x 30 ft. wide and was set up after Pearl Harbor by N. T. Howard and C. D. Brown, who had been operating an automobile sales and service establishment on the premises. With the co-operation of the power sales department of the Lowell Electric Light Corp., a New England Power System subsidiary, the proprietors, like many others in the northeast, decided to convert to war materiel production for the duration. This involved the installation of a 7.5-hp., 550-volt, three-phase induction motor for general group driving; the use of a 110-volt, 2-amp. (L. W. Chuck Company, Toledo) d.c. magnetic chuck on a grinder; supply of 550-volt, three-phase energy to larger motors, 115-volt, two-wire a.c. service to smaller motors and to a rectifier for the chuck, and 230/115-volt, three-wire, single-phase lighting circuits, along with the use of 21 fluorescent units of two 40-watt lamps each in the shop.

Above the work bench in the shop these lighting units are mounted 2 ft. 4 in. over the working plane and 3 ft. 3 in. above the bench level, the tube length being 49 in. About 60-ft.-candles intensity of illumination is delivered upon the work here. There are 18 steps to be taken in manufacturing these dies from the bar stock stage to the inspection of the finished product. Tolerances run between 0.2 and 0.5 of a thousandth of an inch, but parallelism between top and bottom must be within one-thousandth and concentricity for both inside and outside diameters within two one-thousandths. A 7-deg. taper is required in the dies. Seventy-five dies can be ground at a time when held in place on the electric chuck, these being 1 in. in outside diameter. General shop lighting calls for mounting units 7 ft. 4 in. above the floor.

Typical Usage of Energy in Die Plant

Lighting

Month	Kw.-Hr.	Demand, Kw.	Bill
Oct.	504	2.2	$29.22
Nov.	361	2.6	23.54
Dec.	636	3.4	35.28
Jan.	526	3.6	32.58
Feb.	452	3.6	29.08

Power

Month	Kw.-Hr.	Demand, Kw.	Bill
Oct.	1,347	9	$52.10
Nov.	1,016	9	41.82
Dec.	1,790	9	65.54
Jan.	1,362	9	52.12
Feb.	1,278	9	49.61

FLUORESCENT UNITS provide general and localized lighting in converted shop

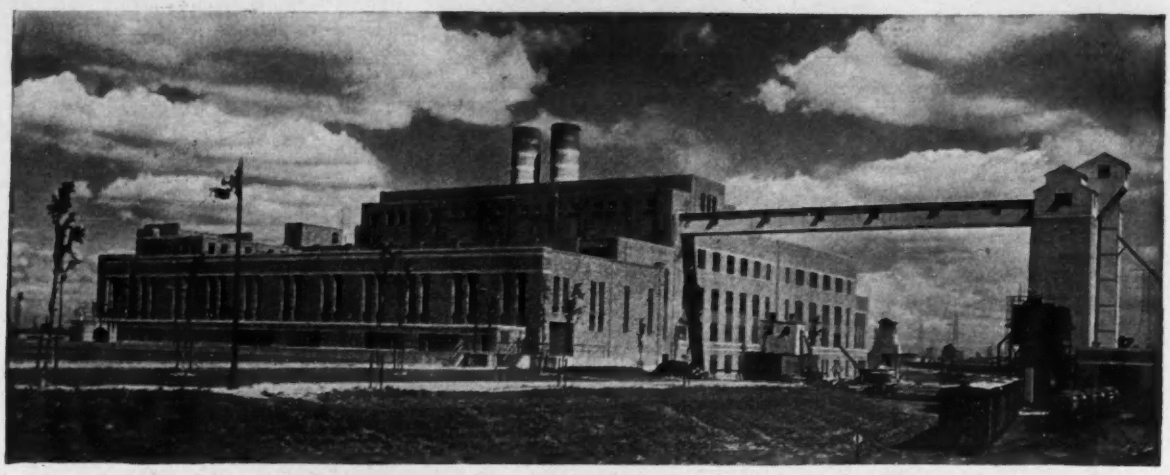
A "Positive" Collection System

As everyone knows, there are two kinds of collection systems. One is the kind that gets the money and the other takes it when it has a mind to float in. The former is positive and is pinned to some definite reason or reasons. The latter is perfunctory at best, if not actually timid.

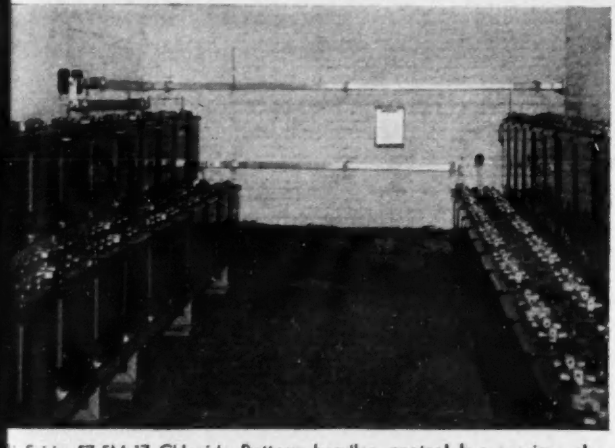
The Washington Water Power Company of Spokane, Wash., is now operating under a positive system, with very good results. As explained by J. E. Winton, assistant treasurer, the company is not afraid that consumers will not eventually pay their bills. But it realized that, in common with others who run bills for merchandise or service, a considerable percentage of its consumers allowed their bills to run past the time limit for current payment. This meant that these accounts became "balance" accounts, and for no very definite reason at all.

Under present conditions, these balance accounts work a hardship on the office because of (1) manpower shortage, (2) difficulty in getting office machinery replacements. The equip-

. . . means Exide Chloride in the world's two largest sewage treatment plants



Peak loads of 1290 million gallons of sewage can be treated per day at Chicago's combined Southwest and West Side Works. The world's two largest sewage treatment plants are Exide-equipped.



This Exide 57-FM-17 Chloride Battery handles control bus service, plus 6000 watt load emergency lighting.

THE world's largest sewage plants provide sewage disposal service for 2,622,500 Chicagoans, plus an industrial sewage disposal equivalent to an added 2,571,500 population. With such a job to handle, no chances on efficiency can be taken.

Naturally, that applies to the battery which operates the controls of the electric power supply system. An Exide Chloride Battery (57-FM-17) supplies the power for operating relays and circuit breakers. It also handles a 6000 watt emergency lighting load.

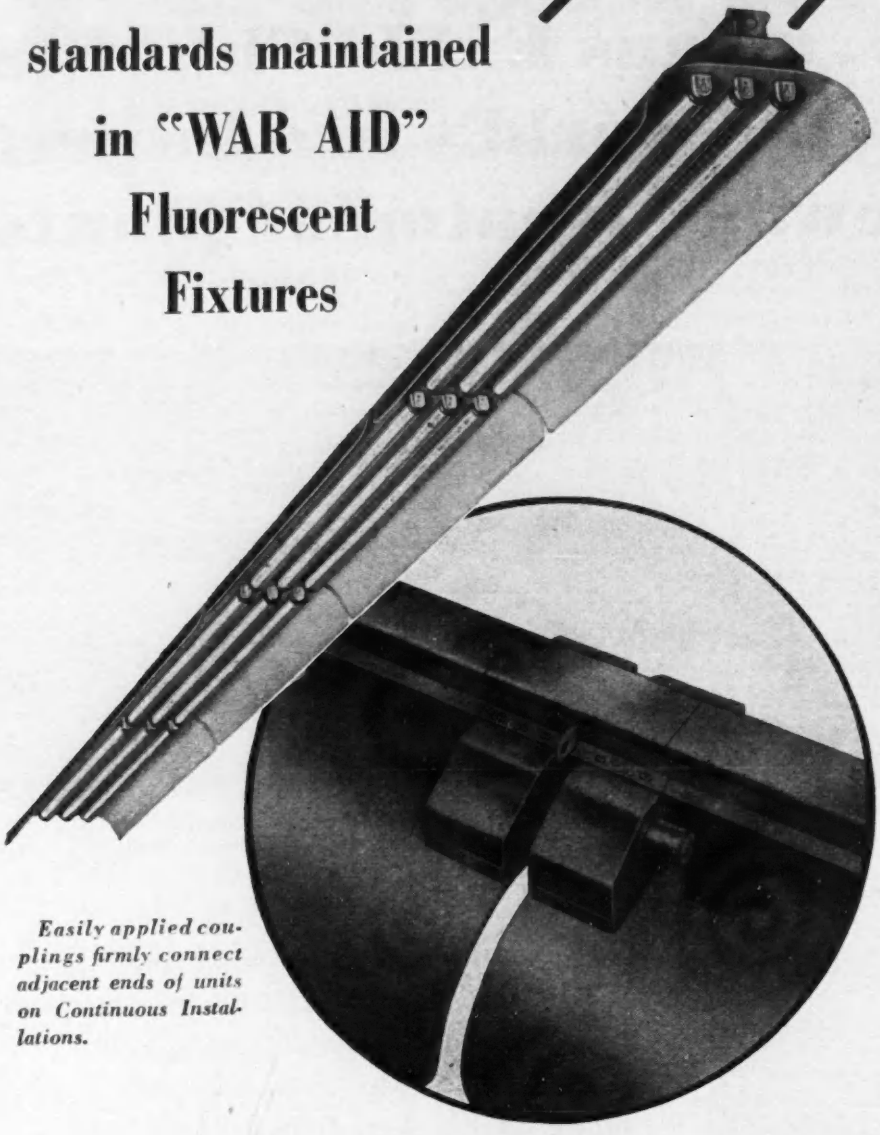
The Sanitary District of Chicago has selected Exide for this vital operation, because these fine batteries have earned a reputation for dependability, long life, and easy maintenance over a long period of years. When you buy an Exide, you *Buy to Last.* Take care of your Exide, and *Save to Win.*

Exide
CHLORIDE
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia • Exide Batteries of Canada, Limited, Toronto

"Skilled" Lighting

standards maintained in "WAR AID" Fluorescent Fixtures



Easily applied couplings firmly connect adjacent ends of units on Continuous Installations.

Wheeler "War-Aid" Fluorescent fixtures are constructed for use with 2 or 3 40-watt lamps, and 2 100-watt lamps. Units are available for Individual or Continuous Installations.

Fixtures have a sturdy metal-conserving wiring channel, non-metallic reflector with chip-proof, washable surfaces. Minimum overall efficiency of 80% for 48" 2 lamp units, 76% for 3 lamp units, and 74% for 60" 2 lamp units.

Units are supplied with loops for chain suspension and with knockout for conduit mounting. In addition, Wheeler "C-Clamp" Sliding Hangers are available which permit fixtures to be mounted from rods, conduit, close to ceiling, or by messenger cable.

Whether you require fluorescent or incandescent illumination, Wheeler can supply Skilled Lighting for precision production. Write for catalogs of both types. **Wheeler Reflector Company, 275 Congress Street, Boston 10, Mass. . . New York. Representatives in principal cities.**

Distributed Exclusively Through Electrical Wholesalers

Wheeler REFLECTOR COMPANY

Lighting Equipment Specialists Since 1881

ment became overloaded simply through carrying balances.

This being the case, it was decided to put the problem squarely up to the consumer and ask for his co-operation in solving it. Therefore, a consumer education campaign was started, through:

1. Newspaper advertisements wherein the theme was co-operation with the company to enable the latter to get the work done under wartime conditions. It was explained how they could help by going from the slow pay habit, which after all is only a peacetime luxury, to prompt pay, and how that would save manpower and equipment.
2. A small folder was produced, explaining the situation and seeking co-operation. Special representatives called on the slowest pay consumers, solicited co-operation by word of mouth and left the folder. On the back, this lists pay stations convenient to all. The folder was also inclosed with bills to all balance accounts.
3. An announcement stuffer, with the same message boiled down, was mailed to every consumer with the monthly bill.
4. Finally, as a finishing touch, a type of "Thank You" newspaper advertisement was run.

This went on over a period of five months, with good results from two standpoints: (1) Marked reduction in number of accounts carrying balances. (2) Belief on the part of employees in direct contact with the consumers that the activity, put on this straightforward, co-operative basis, has not been a detriment to good public relations.

In the last three years the number of consumers has been increased by 4,000, a large part of this increase being recently. Yet all these accounts are being handled with the same office mechanical equipment, partly made possible in recent months by a large number of consumers giving up the practice of running bills.

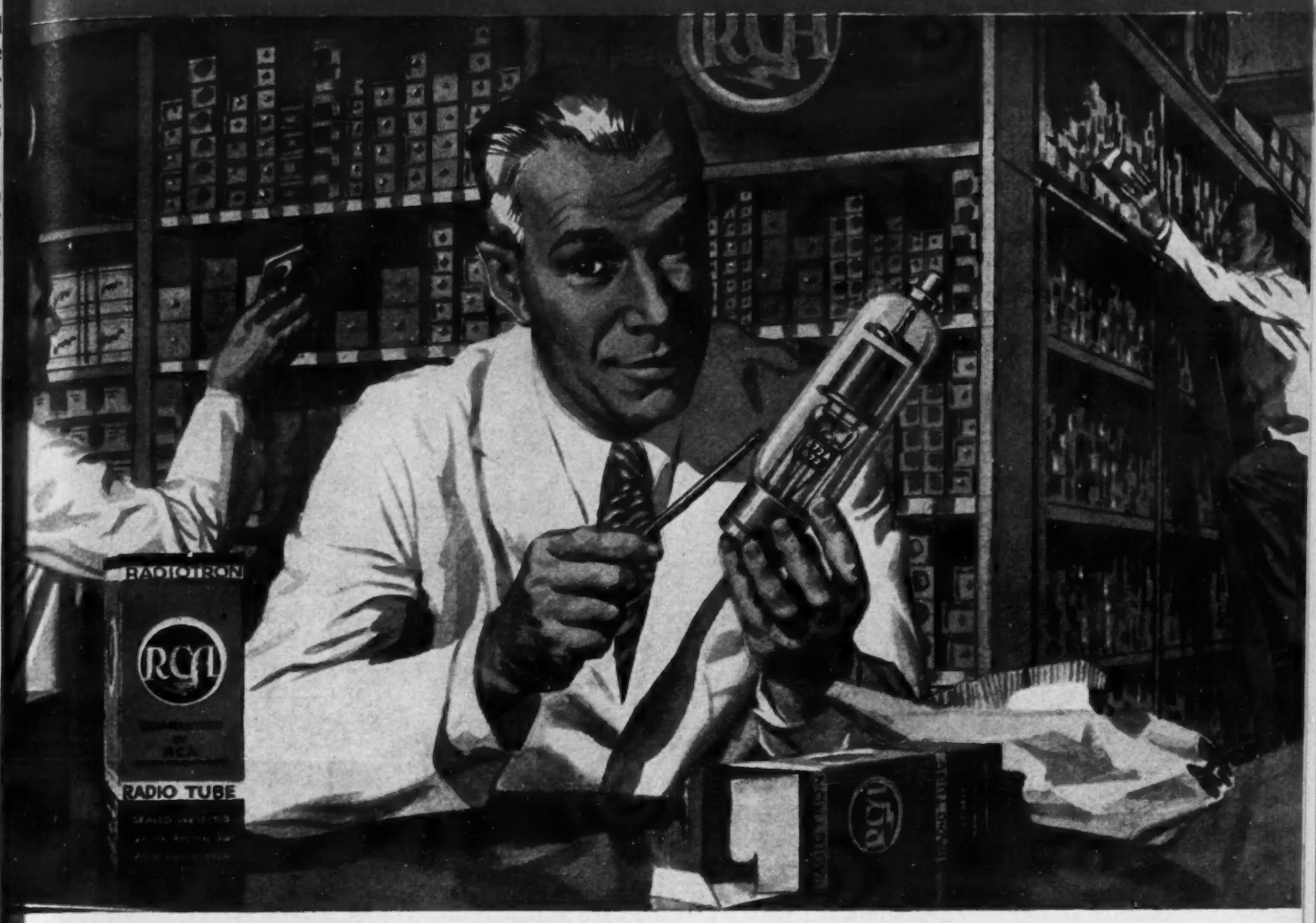
•

Electric Service Aids Celery Farms

By FRED VOS
Farm Service Engineer
Consumers Power Company

Along the small creeks and rivers in the vicinity of Muskegon, Mich., there are a number of muck farms where the principal crop is celery. The location of these farms is such that when the rivers or creeks are high, or when there are severe rainstorms, natural drainage is almost impossible. Under these conditions most of the celery farmers reported that about one out of three years

NEED HELP FAST?



See your local RCA Tube and Equipment Distributor

— your *Emergency Electronic Expediter*

RIGHT around the corner is a man you ought to know: your own local RCA Tube and Equipment Distributor.

Tackling tough jobs is his business—like locating tubes and other electronic equipment when you need them in a hurry to fill some priority order. For all you know, he probably carries them in stock. Can't hurt to find out anyway—and he may be able to save you a whole lot of trouble and unnecessary delay!

He has the kind of technical "know how", too, that you'll find mighty useful. His angle on how to use a piece of equipment is well worth listening to. Remember, the chances are he's been in radio since its early knee-pants days.

So next time you're stuck for stock, need something electronic in a howling hurry, or find yourself up against something that takes intelligent and tradewise expediting, get in touch *right away* with the man we've picked to serve as your *Emergency Electronic Expediter.*

If you don't know who he is, write us today.

...*for* TECHNICALLY INFORMED SERVICE

NORMALLY ADEQUATE STOCKS

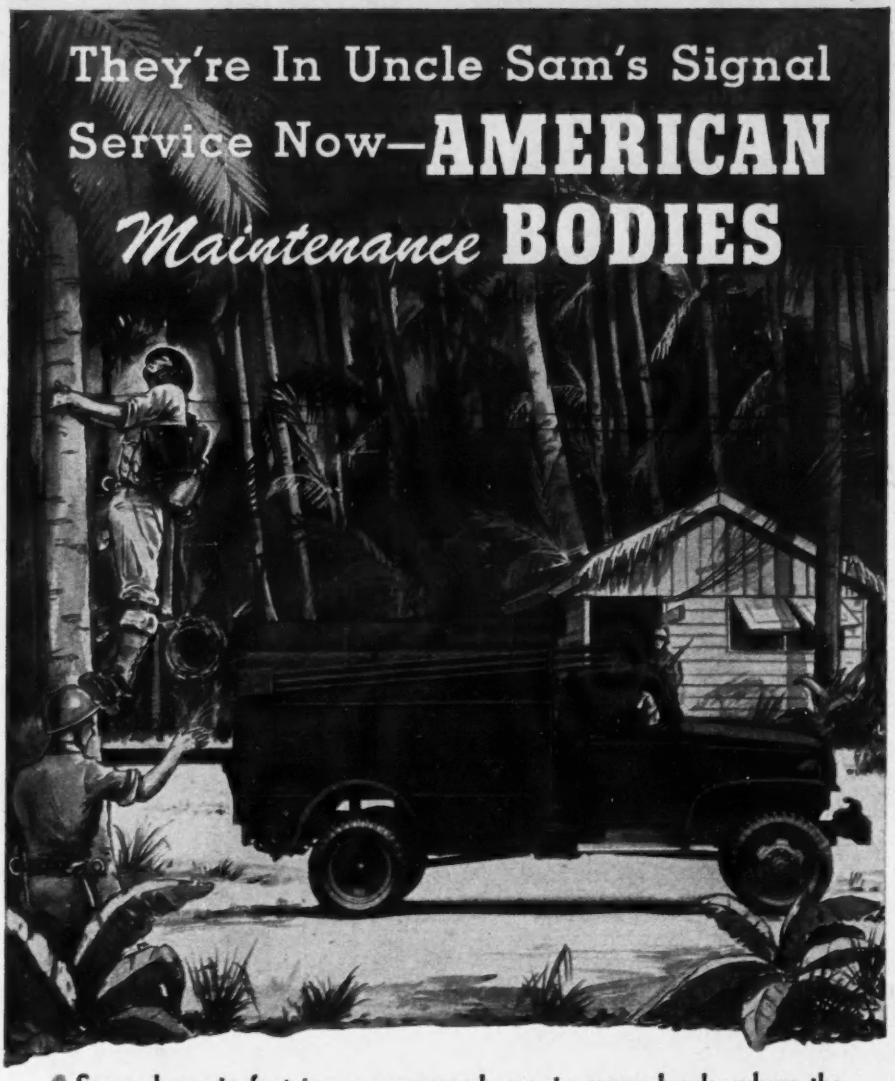
FAST DELIVERIES

INTELLIGENT EXPEDITING

RCA ELECTRON TUBES

RCA Victor Division • RADIO CORPORATION OF AMERICA • Camden, N. J.

They're In Uncle Sam's Signal Service Now—AMERICAN *Maintenance* BODIES



● Somewhere, in fact in many somewheres, in many lands, where the Signal Corps men of Uncle Sam's forces are fighting, "American" Bodies are in service.

Sturdily constructed in accordance with "American's" top quality and skilled workmanship and equipped, in a majority of cases, with "American" winches, power take-offs and accessories, "American" Maintenance Bodies are standing up under the roughest, toughest going, helping the men of the Signal Corps maintain vital communications.

"American" is indeed proud of the fact that it has been able to serve our country, by the construction of equipment for the United States Signal Corps, the Engineering Corps and the Ordnance Department.

But we are not forgetting for an instant our responsibility to the utilities whom it has been our privilege and pleasure to serve for many years. With the close of hostilities "American" will be ready to make deliveries as fast as truck chassis are available.

Some Reasons Why "Americans" Are TOPS:—

Correct Design • Superior Quality Construction • Comfort • Convenience • Safety • Endurance • Low Operating Cost • Fine Appearance

THE *American* COACH & BODY CO.

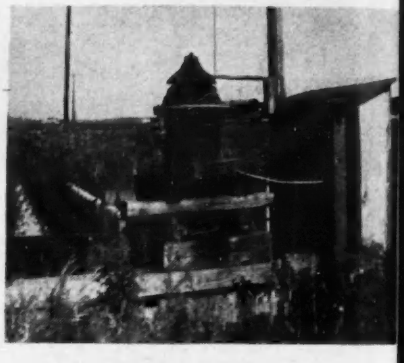
WOODLAND AVE. AT E. 93rd ST., CLEVELAND 3, OHIO

PUBLIC UTILITIES EQUIPMENT FOR MOTOR VEHICLES

crops was almost a complete loss du to high water.

In developing marshy soils th first problem to be considered is t get the water off the land and hol the water level at a uniform distanc below the surface. The second con sideration is that of protecting the land from flooding during we weather. By throwing up a dyk around the plot of ground and usin an electric pump to lift the water over the dyke or dam excess water can be removed and the water table held at a constant level through the use of an automatic float switch. The follow ing is an example of how the firs electrically operated drainage project in the Muskegon area was developed. In the spring of 1939 the rural de partment of Consumers Power Com pany started a project to drain 1 acres of this muck land.

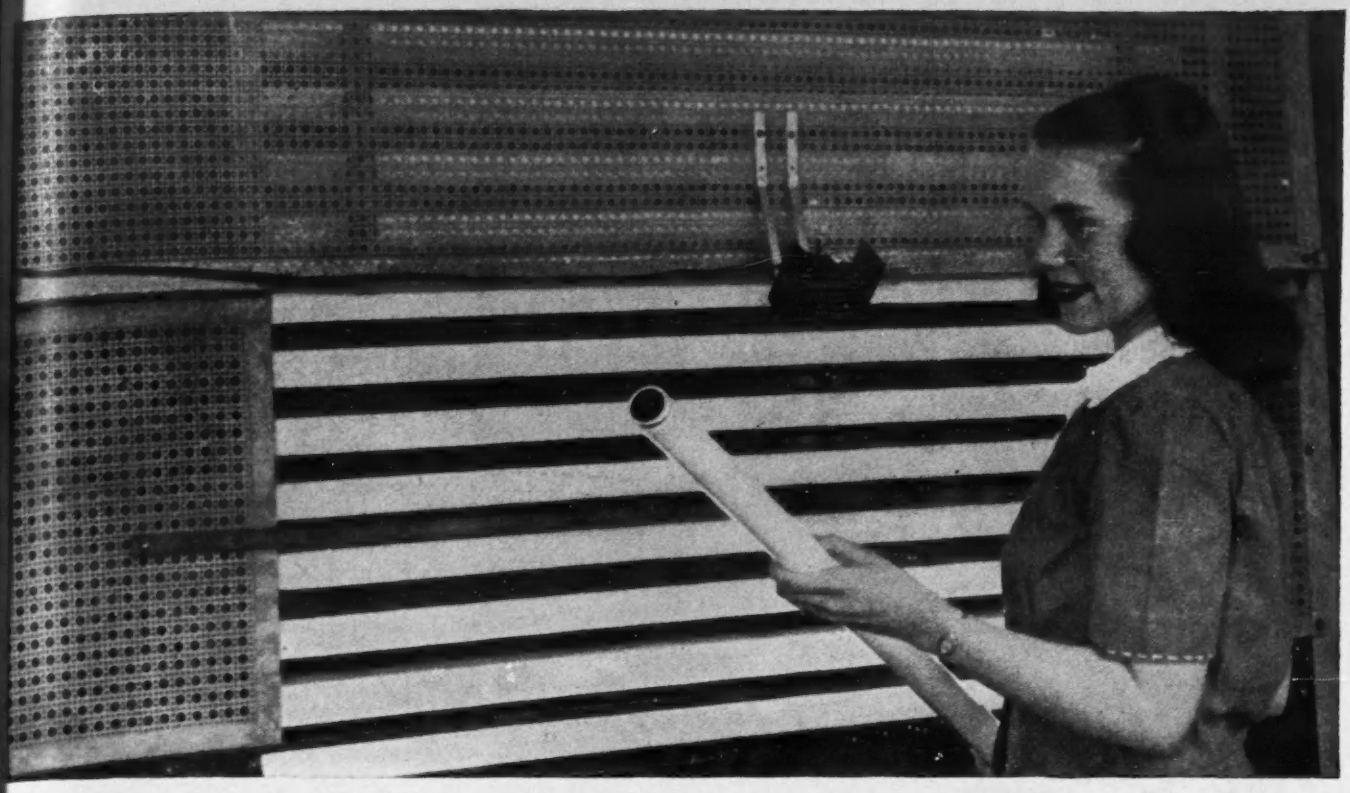
A ditch was dug parallel with the creek which bordered the piece of land and the dirt which was removed was used for a dyke. From this main ditch lateral ditches were dug 60 ft apart. At the lower end of the ditch a sump was dug and a pump operated



CELERY FARM drainage pump

by a 7½-hp. electric motor was in stalled in it. The motor was operated automatically by means of a float switch. By means of this pump the water table was held at from 18 in. to 2 ft. below the surface, which, accord ing to Michigan State College, is the proper level for best results with celery.

The project was so successful that it did not take the other celery farm ers long to decide to put in similar drainage systems on their muck plots Good muck land well drained is valu able, but if poorly drained it is al most worthless. It was found that the type of drainage here described give complete control of moisture and is not expensive. There are now 2 pumps in use in the Muskegon are



AGE BEFORE DUTY..

• When properly "aged" or seasoned, fluorescent lamps remain more constant than daylight throughout their entire life. This is important in lamps that illuminate precision work in war plants.

At Sylvania there is a special "age before duty" machine that lights and relights fluorescent lamps for carefully regulated time intervals. This mellowing process prepares all the elements that make up a lamp for a life of uniform light output. It is also a final precaution taken to weed out an occasional substandard lamp which may have filtered through dozens of painstaking inspections.

That is why a Sylvania Fluorescent Lamp can be counted on for consistent light output every minute of its life.

"Aging" is one of many Sylvania methods of safeguarding fluorescent quality. Lamp efficiency is perfected and maintained at its highest peak through continual research by Sylvania engineers who have years of specialized experience with incandescent lamps, radio tubes, ultra-violet lamps and other electronic devices.

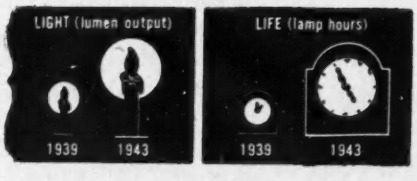
Today Sylvania's research is providing the best and most economical lighting known for war industry. When victory is won, the same independent research will bring the advantages of fluorescent lighting to postwar homes.

For more light output, longer life and uniform color, specify Sylvania Fluorescent Lamps in new installations and replacements.

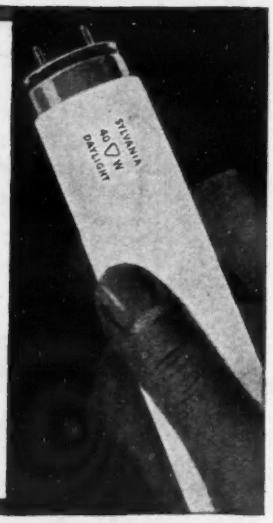
SELL SYLVANIA AND GIVE YOUR CUSTOMERS FAR MORE LIGHT AND LIFE FOR THEIR MONEY

Compared with 1939, a dollar invested today in Sylvania Fluorescent Lamps buys more than four times the lumen output and approximately five times the lamp life.

SYLVANIA FLUORESCENT DOLLAR BUYS:



(Based on decreasing price and increasing efficiency and durability of Sylvania 40-Watt White Fluorescent Lamp)



SYLVANIA

ELECTRIC PRODUCTS INC.

Formerly Hygrade Sylvania Corporation

Salem, Mass.

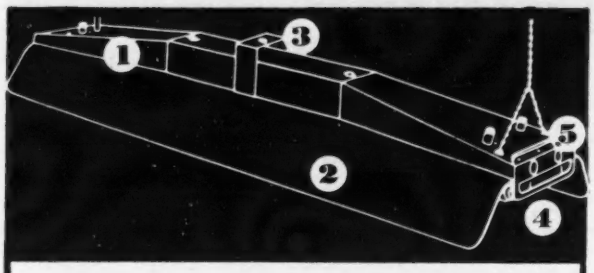
INCANDESCENT LAMPS, FLUORESCENT LAMPS, FIXTURES AND ACCESSORIES, RADIO TUBES, CATHODE RAY TUBES, ELECTRONIC DEVICES

HERE'S THE NEW...

Guth SUPER ILLUMINATOR

U.S.T.M. REG. & PATS. PENDING

The Latest and Best IN FLUORESCENT LIGHTING!



EFFICIENT!

SIMPLE!

PRACTICAL!

ATTRACTIVE!

Easy-to-Clean!

1. Ingeniously engineered Accessory Housing—long—lean—good looking—and tough! Meets W. P. B. metal limitations. Die-formed from a single piece of steel.
2. Masonite "REFLECTOR-BOARD" Reflectors; formed in our plant, rigidly checked, quality controlled. Finished "300° White" (88% R. F.). Reflector easily removed and reinstalled, with Flexible "Triggers."
3. Hang it anywhere—anyway! K. O.'s for conduit and chain. Sliding hanger for outlet spacing variations.
4. Supports for Eggcrate Louvres, when desired. Louvres can be attached to standard units, initially or at later date.
5. "Bump-Proof" end-plates give added lampholder protection. Starters easily accessible even when SUPER-ILLUMINATORS are mounted directly to ceiling.

For full details on the GUTH Super-Illuminators, Write for Catalog Sheet No. 744.

Leaders in Lighting Since 1902 Guth

THE EDWIN F. GUTH CO. • 2615 Washington Ave. • St. Louis, Mo.

operating on muck forms of from 3 to 30 acres each, totaling 335 acres.

Most of the pumps are propeller type, and a number have been built by local blacksmiths or by the farmers themselves. Because of the low lift, the propeller pump is entirely satisfactory. Energy used and cost of pumping are variable according to rainfall in the year. In 1940 the average kilowatt-hours per acre per season were 57; in 1941, 59, and in 1942, 71. The costs per acre per season for the three years were respectively $2.67, $2.75 and $3.20. Considering the value of the crops, these costs for electricity are very cheap insurance.

There have been many visitors from outside the state of Michigan inspecting these Muskegon drainage projects and detailed information will gladly be supplied by the owners or Consumers Power Company to those interested.

•

Wanted and Surplus

For 1½ years the Idaho Power Company has carried on a continuous campaign to place surplus equipment wherever located in its territory. This is done by means of the "Commercial and Industrial Bulletin," an activity of the commercial department under Orland C. Mayer, manager.

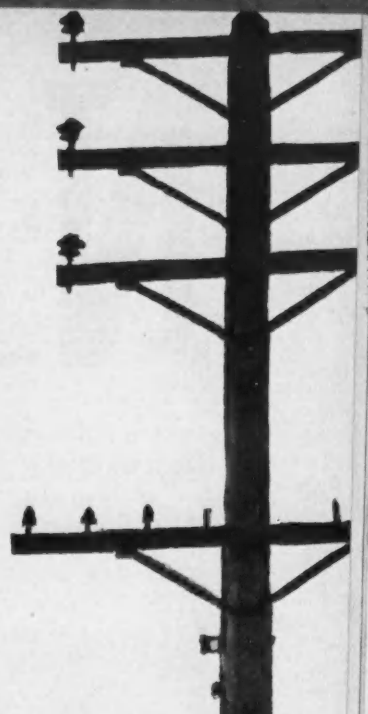
The multigraphed bulletin, issued monthly, runs to three or four pages and comprises a "W and S" (Wanted and Surplus) equipment record. The first page contains "W" listing under the heads "Item Wanted," "Brief Description, " "Name of Inquirer" and "Address." This is followed by "S" equipment under similar heads.

The final page is a blank form for entering information as to "W" and "S" equipment to be carried in the next bulletin.

Distribution of the bulletin is to all branch managers, all company commercial and industrial engineers and industrial and commercial customers of the company.

Response to this is wholly voluntary on the part of the customers. There is no staged campaign on the part of the company to solicit customers to list equipment or wants. However, the results have been good and the response continues to be as active as when the plan was first started.

LIFE SPAN'S *Decay-Immunity* GROWS!



NEW LABORATORY TESTS PROVE That Time INCREASES Penetration!

INNER SAPWOOD RESISTS MOST SEVERE DECAY TESTS

It had been suspected—now laboratory tests have proved it! The penetration and effective diffusion of Life-Span tox-i-tizing treatment actually increase with time! Tests, made on samples of inner sapwood taken after one to three years of pole service, showed that measureable quantities of pentachlorophenol had permeated the entire sapwood—and that these "untreated" sections resisted severe decay innoculations. This new evidence gives added testimony to the "life" insurance value of the Life-Span process. Full length tox-i-tizing means full length —and full depth—decay resistance—"Complete sapwood protection"! Specify Life-Span!

UNTREATED SECTION BECOMES TOX-I-TIZED

Amazing results have been shown in tests made on Life-Span poles after 1 to 3 years of service. In above sample section are shown:

A—Sapwood
B—Heartwood
C—Depth of penetration on original treatment
D—Untreated inner sapwood portion subjected to chemical analysis and tests.

Careful laboratory experiments proved: That, by diffusion and "creep", pentachlorophenol had permeated entire sapwood; that this inner sapwood could not be decayed under the most severe decay conditions!

Life Span

Sold only by these companies

PAGE AND HILL CO.
Minneapolis, Minn.
50 Church St., New York, N. Y.

B. J. CARNEY & CO.
Spokane Minneapolis

SCHAEFER-HITCHCOCK CO.,
Sandpoint, Idaho, Supplier for Joslyn

NAUGLE POLE AND TIE CORP.
Minneapolis, Minn.

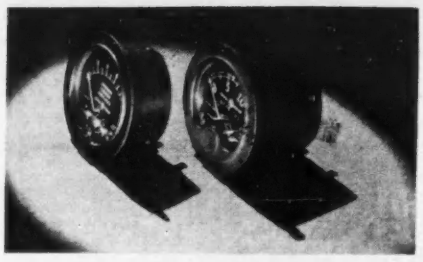
CONSOLIDATED TREATING CO.

MINNEAPOLIS MINN.

NEW EQUIPMENT

Instruments

New line of thin d.c. instruments features an internal-pivot construction. Pivots are solidly mounted on the inside of the armature shell instead of being secured to the outside of the armature winding in



Types "DW-51" and "DW-52" d.c. panel instruments; brass or Textolite dustproof and moisture-resisting cases in 2½-in. sizes; accuracy within plus or minus 2 percent of full-scale. (Type DW-52 at left, type DW-41 of conventional construction at right). **General Electric Co.**, Schenectady, N. Y.

the conventional manner. One jewel bearing is mounted rigidly on top of the core-and-frame assembly, and the other in an adjustable sleeve fitted into the lower part of the soft-iron core. Element assembly is a single, self-contained unit, all parts of which are supported by a high coercive cast magnet. Type DW-51 includes voltmeters, ammeters, milliameters and microameters. Type DW-52 includes radio-frequency ammeters and milliameters of d.c. thermocouple type.

•

Control Element

"Flashtron" electronic unit; 115 volts, 60 cycles. **Thordarson Electric Manufacturing Co.**, 500 W. Huron St., Chicago, Ill.

Inclosed control unit can be operated from super-sensitive primary actuating elements and furnishes the power for acuation of power operating elements. Its two output circuits accommodate the alternate energizing of loads; one of the circuits is always energized but both cannot be energized simultaneously with contactor type actuating devices. The loads might be heating elements and motors for valve control and blowers.

•

Humidifier

"Little Giant E-120" industrial humidifier; capable of dispensing water at the rate of 42 lb. per hour with 5 lb. steam pressure or 120 gal. in 24 hr. **Techtman Industries, Inc.**, 828 North Broadway, Milwaukee, Wis.

Humidifier, 10 in. long and 3 in. diameter, may be installed in single units or in clusters. Steam is conducted from interior of an upright receptacle through a valve to interior of the humidifying chamber and reaches atmosphere through a downwardly extending tube. Desired relative humidity is obtained by adjustment of a screw at top of the unit. Accumulated surplus condensate can be drained back into steam riser or into a vacuum return line.

•

Welder

"Ampco-400" welder; range 50 to 500 amp. **Allis-Chalmers Mfg. Co.**, Milwaukee, Wis.

New self-cooled unit added to the company's line of welders will handle ¼-in. electrodes on the basis of 24-hr.-a-day continuous operation and ample capacity is provided for rods up to ⅜-in. size when needed, according to the manufacturer. Power factor correction is available if desired. Features listed are: low idling loss, high power factor, and high efficiency over entire range.

•

Lighting Units

Line of lighting fixtures has been augmented by the former Chase products which are now offered in two styles. Reflectors are made of Plaskon, a urea formaldehyde

"Commander" and "Alden" semi-indirect lighting units; use 200 to 750-watt lamps; former available in either close-connected ceiling or semi-rigid-suspension types, latter in suspension type and for use with silvered-bowl lamps. **The F. W. Wakefield Brass Co.**, Vermillion, Ohio.

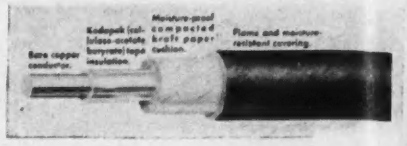
BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

plastic, which, it is stated, is not subject to breakage due to temperature changes, has a weight approximately one-quarter of that of other reflecting mediums of comparative size, and can be cleaned by wiping with a damp cloth.

•

Wire

New type of wire is a copper conductor with rubberless insulation as indicated in the illustration. As no rubber insulation


Bare copper conductor.
Kodapak (cellulose-acetate butyrate) tape insulation.
Moisture-proof compacted kraft paper cushion.
Flame and moisture-resistant covering.

"Hazapak" building wire; available in all regular sizes for 600-volt ratings. **Hazard Insulated Wire Works Division, The Okonite Co.**, Wilkes-Barre, Pa.

is involved, the conventional tin coating for the conductor is no longer necessary, thus conserving critical materials. The wire can be supplied in all standard colors with full face identification markings and footage measurements Overall diameters are same as for type R wire.

•

Plugs and Sockets

"Series No. 2400" plugs and sockets; sizes 2, 4, 6, 8, 10 and 12 contacts. **Howard B. Jones**, 2460 W. George St., Chicago 18, Ill.

Plug and socket bodies are of molded bakelite and are furnished with either a shallow bracket for flush mounting, deep bracket for recessed mounting or with metal cap with or without cable clamp. Socket contacts are phosphor bronze, silver plated and have four individual flexing surfaces to make contact with each plug-prong of ¼ x ⅛-in. brass silver plated.

•

Rotary Converters

For use in locations where direct current only is available, two-pole converters can be used for operating standard a.c. appliances, electric signs, coin-operated machines, etc. When used for radio and electronic equipment, filters may be furnished which are contained in sheet metal base upon which the converter is mounted.

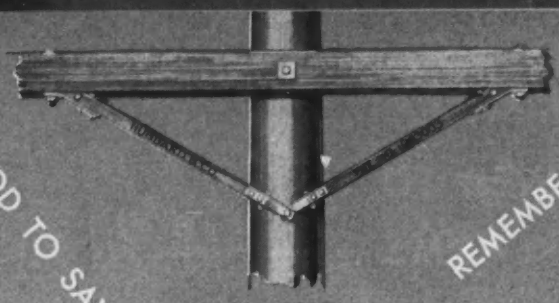
Rotary converters; capacities 225 and 350 volt-ampere continuous, 40 deg. C. rise, 3,600 r.p.m., 32, 110 or 220 volts d.c. to 110 volts 60 cycles. **Kato Engineering Co.**, Mankato, Minn.

OD IS A WEAPON—DO NOT WASTE!

YOUR BLOOD TO SAVE A LIFE!

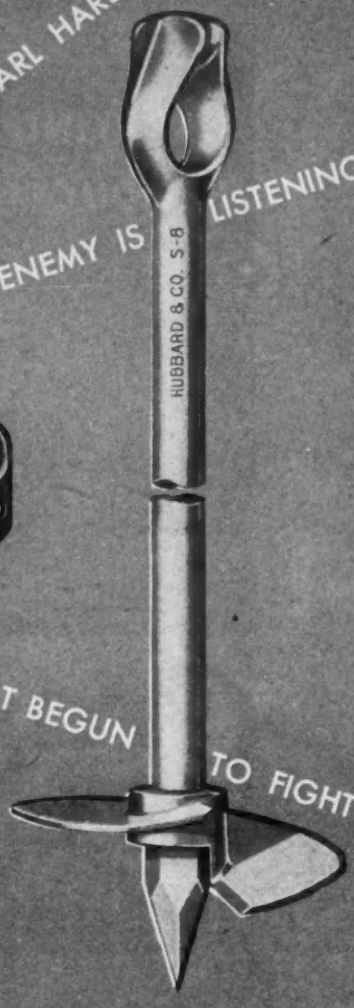
REMEMBER PEARL HARBOR!

BE CAREFUL—THE ENEMY IS LISTENING!



No. 3547
Wood Brace

No. 7753
Stubbing Band



No. 7328
Steelwing Anchor

KEEP 'EM FLYING!

WE HAVE JUST BEGUN TO FIGHT!

10% EVERY PAYDAY!

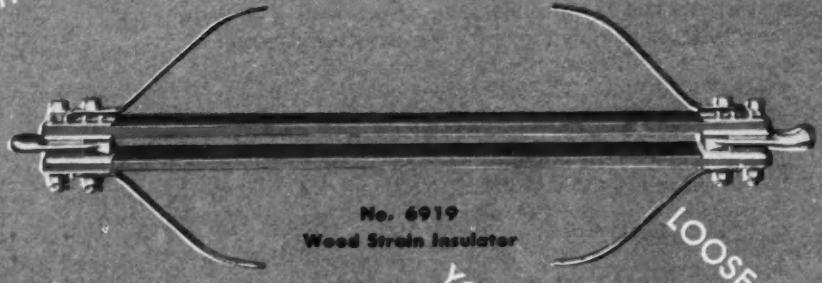
Hang the load on HUBBARD HARDWARE!

No. 1358
Secondary Rack

OIL IS AMMUNITION—USE IT WISELY!

LET'S CLEAN IT UP IN '43!

BUY WAR BONDS AND STAMPS!



No. 6919
Wood Strain Insulator

No. 1330
Insulated Clevis

LOOSE TALK SINKS SHIPS!

YOU'VE DONE YOUR BIT—NOW DO YOUR BEST!

UNITED WE ARE STRONG—UNITED WE WILL WIN!

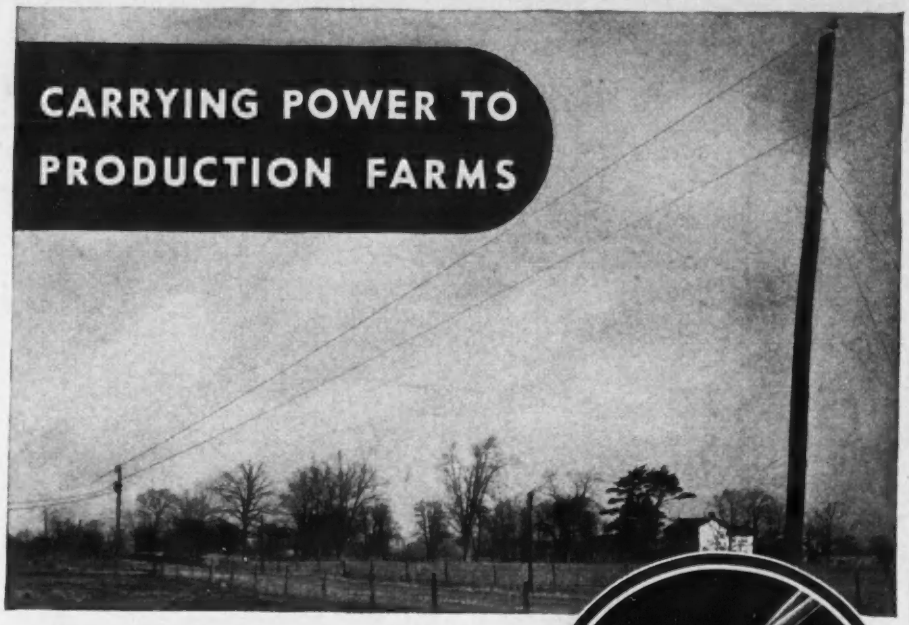
No. 4-11-44
Wireholder

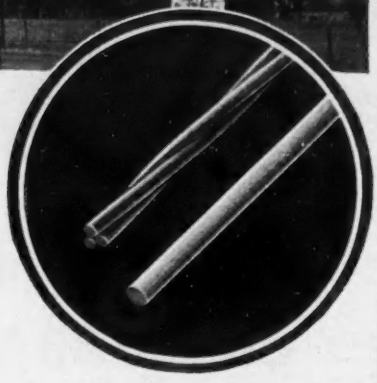
HUBBARD

HUBBARD AND COMPANY

PITTSBURGH OAKLAND CALIFORNIA CHICAGO

BACK THE ATTACK WITH WAR BONDS!





Crapo STEEL CONDUCTOR

THOUSANDS of the nation's food producing farms are being electrified during this critical period, thanks to *Crapo* Steel Conductor. This efficient conductor material—conceived during World War I, perfected and proved in on rural lines during the peace years—was ready to meet the needs of the current war emergency when these arose.

Crapo Steel Conductor, developed specifically for the overhead transmission and distribution of power, provides a combination of physical strength and electrical efficiency never before available in ferrous wire.

Its extra high tensile strength makes possible long spans with flat sags and greater ground clearances, reduces the number of pole structures required, saves critical man-hours and materials. Electrically, this conductor is unique because of its low 60-cycle resistance, low magnetic permeability and low 60-cycle reactance.

Write for New Engineering Manual

For rural extensions authorized by Utilities Order U-1-c, specify No. 6 B.W.G. *Crapo* HTC-130 Stranded (3-wire) Conductor—the size and type recommended for the purpose!

For information on other applications, contact the nearest office of the Graybar Electric Company Inc., Distributors! Or, write direct for the new engineering manual containing complete information about *Crapo* Steel Conductors!

INDIANA STEEL & WIRE COMPANY
Muncie . . . . Indiana

Crapo HTC-130 STEEL CONDUCTORS

TECHNICAL LITERATURE

BRUSHES—A pamphlet "Carbon, Graphite and Metal-Graphite Brush Standards" is devoted to the standard dimensions and tolerances for the respective brushes, and to standards for parts such as shunt cables, clips and connections. An entire section contains definitions for brushes, thus promoting uniformity in the language used for referring to these parts. The publication No. 43-85 may be obtained from the National Electrical Manufacturers Association, 155 East 44th St., New York, N. Y. at 25 cents per copy.

RELIEF VALVES—Factors determining size of valve for protecting low pressure equipment and data to show how size and permitted pressure drop affect the capacity that can be handled are presented in publication No. 26, "New Sizing Data On Relief Valves." This publication is available from Cochrane Corp., 17th and Allegheny Ave., Philadelphia, 32, Pa.

INSTRUMENTS — "Electric Instruments Principles of Operation" is a publication presenting a concise discussion of the characteristics of instruments, what makes them operate, and the individual limitations of the various types. Designated GET-1173, it is available from the General Electric Co., Schenectady, N. Y.

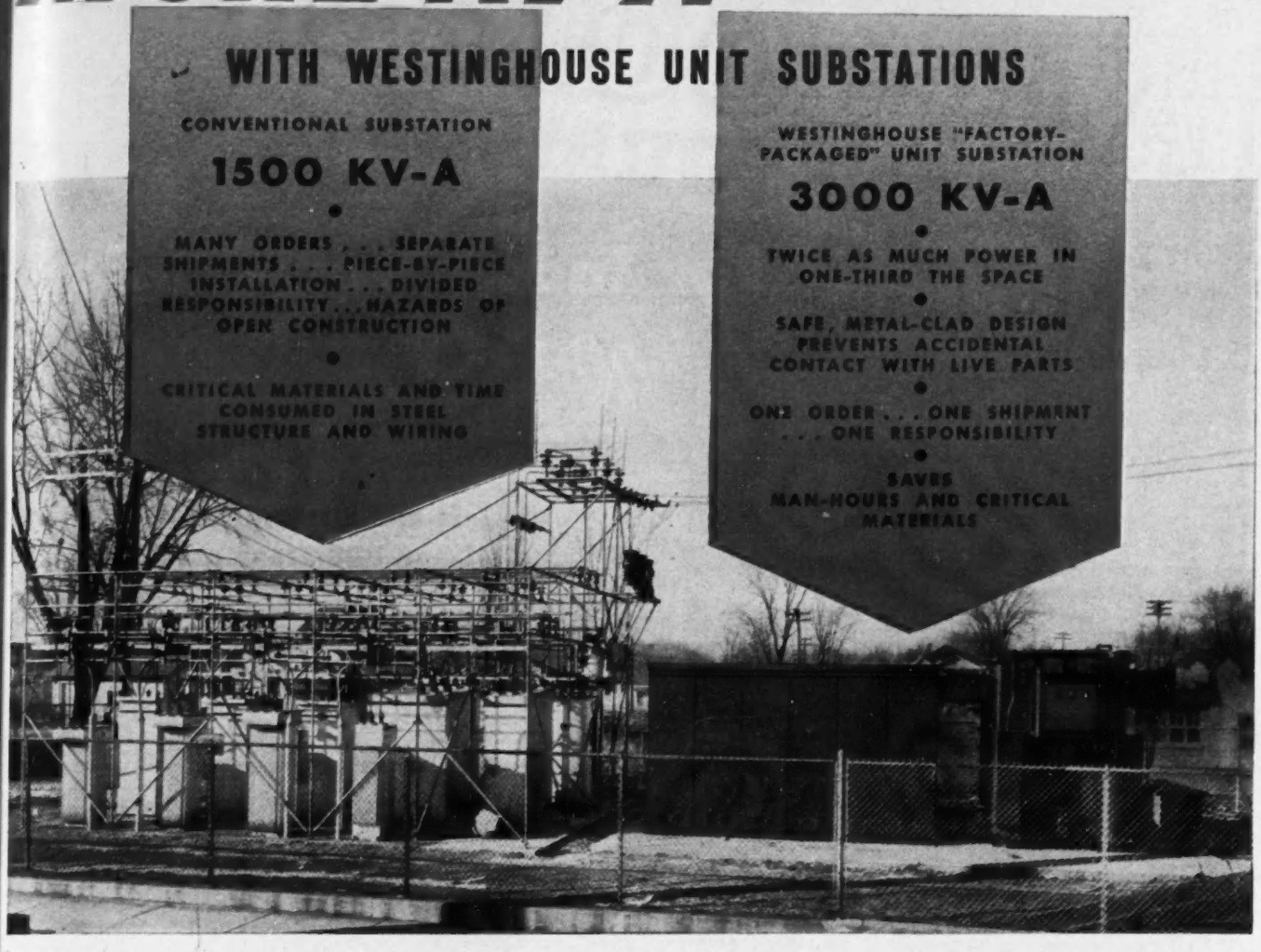
DIESEL ELECTRIC PLANTS — "Victory Maintenance Plan for Diesel Electric Plants" covers information on the necessary steps for maintenance and inspection programs, mechanical and electrical check charts based on frequency of inspection and a sample form of a recommended diesel engine operating log to determine the proper scheduling of inspection intervals. The book has been prepared by diesel engine manufacturers and the Westinghouse Electric & Mfg. Co., Copies can be obtained from diesel engine builders.

WELDER'S GUIDE—A 20-page booklet explains the three essentials of welding procedure, illustrates, explains what is wrong and gives corrections of faulty welds, illustrates welding symbols and all kinds of joints and fillet welds, and contains a trouble check chart on welding machine troubles. "Vest Pocket Guide for Welders" EW-95, is available from the Hobart Brothers Co., Troy, Ohio.

WHITE CONCRETE FLOORS—A new type of light-reflecting floor installed in aircraft and other war plants is described in a new 24-page book, "Light From Floors Speeds War Production," published by Universal Atlas Cement Company, Chrysler Building, New York. According to the text it was prepared in collaboration with various authorities on illumination, design and construction. Examples in the book show how a white-cement floor compared with a gray-cement floor in the same plant reduces shadows and dark areas; promotes easier seeing by reducing the contrast between the visual task and the surrounding background; increases lighting on underside work surfaces by 61 percent; increases illumination on vertical work surfaces by 20 percent. The book concludes with a section on recommended practice for construction, a section on surface treatment of floors, and a section on maintenance experience which shows that white-cement floors are easy to keep clean, encourage cleanliness and retain their reflection advantage.

MORE KV-A PER CUBIC FOOT

WITH WESTINGHOUSE UNIT SUBSTATIONS


CONVENTIONAL SUBSTATION
1500 KV-A
MANY ORDERS . . . SEPARATE SHIPMENTS . . . PIECE-BY-PIECE INSTALLATION . . . DIVIDED RESPONSIBILITY . . . HAZARDS OF OPEN CONSTRUCTION
CRITICAL MATERIALS AND TIME CONSUMED IN STEEL STRUCTURE AND WIRING
WESTINGHOUSE "FACTORY-PACKAGED" UNIT SUBSTATION
3000 KV-A
TWICE AS MUCH POWER IN ONE-THIRD THE SPACE
SAFE, METAL-CLAD DESIGN PREVENTS ACCIDENTAL CONTACT WITH LIVE PARTS
ONE ORDER . . . ONE SHIPMENT . . . ONE RESPONSIBILITY
SAVES MAN-HOURS AND CRITICAL MATERIALS

Better than words, this photo shows why Westinghouse "Factory-Packaged" Unit Substations offer a more satisfactory answer when power capacity must be expanded . . . quickly.

In this case, a Midwestern power company had to triple the capacity of the 1500 Kv-a conventional substation, shown at the left, to meet suddenly expanded war demands. Instead of ordinary equipment, a Westinghouse Unit Substation (shown at right) was ordered.

Result: twice as much additional power in one-third the space — installed in less time than would have been required to erect the steel structure alone for a conventional substation.

Westinghouse Unit Substations make these advantages possible because all the many parts of a conventional substation are "packaged" at the factory into one compact unit. And long-time dependable performance is assured by the "Unitized" Switchgear and Transformer Assembly.

★ ★ ★

Get full details on Westinghouse Unit Substations. For complete information, call your Westinghouse Office. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

J-60529

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Westinghouse

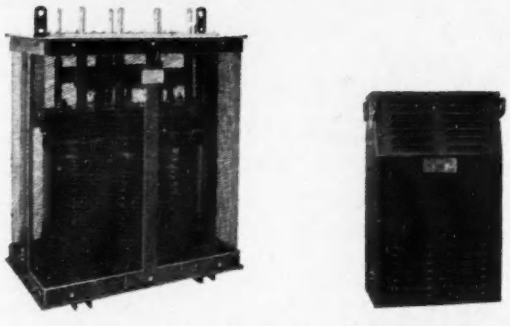
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

UNIT SUBSTATIONS

MOLONEY AIR-COOLED TRANSFORMERS

For Indoor Installation *Without* Fireproof Vaults

600 Kva, 3-Phase Type BDL Air-Cooled transformer with Class B insulation. Rated 13800 volts delta primary to 460Y/266 volts secondary with 6-2½% taps available on terminal board located on side of transformer.



Left: 150 Kva Type BDL transformer. Type BDL is supplied in sizes from 150 to 1500 Kva in primary voltages from 480 to 13800 volts. *Right:* Type BDC. This type is supplied in sizes 15 to 100 Kva in primary voltages from 480 to 4800 volts.

It's Safe and Economical to Install Type BDL and BDC Transformers Indoors

THESE Air-Cooled transformers are insulated with approved Class B materials including glass, asbestos and porcelain. Since no cooling liquid is used, fire and explosion hazards are eliminated and Type BDL and BDC transformers may be safely installed at load centers without the expense of vault construction.

Because of the absence of a cooling liquid, there is practically no maintenance cost when using either Type BDL or Type BDC Air-Cooled transformers. There is no liquid to require periodic testing and conditioning. There are no valves, no gasketed surfaces, no cooling tubes or radiators to maintain.

Type BDL transformers are contained in expanded metal cases and Type BDC in louvered sheet-metal cases. Both types of cases are attractive in appearance and make the most effective use of cooling air for the particular design of the windings involved. Large cooling ducts are provided in the windings to permit rapid movement of a large volume of cooling air. The windings are designed to provide a maximum amount of coil surface for efficient cooling.

Moloney Air-Cooled transformers with Class B insulation may be used safely and economically in all industrial applications.

MOLONEY ELECTRIC COMPANY • ST. LOUIS, U. S. A.

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Birmingham, Ala. . . . . 1814 First Avenue, North	Houston, Texas. . . . . 4411 Navigation Blvd.	Pittsburgh, Pa. . . . . 837 Oliver Bldg.
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Dallas, Tex. . . . . 709 Thomas Bldg.	Minneapolis, Minn. . . . . 521 Midland Bank Bldg.	Seattle, Wash. . . . . 532 First Avenue, South
Denver, Colo. . . . . 612 Insurance Bldg.	New Orleans, La. . . . . 428 Balter Bldg.	Shreveport, La. . . . . 630 Spring Avenue

NEWS ABOUT PEOPLE

Wollaston Heads T. & D. Division in Vancouver

F. O. Wollaston has been appointed superintendent of the transmission and distribution division of the electrical department of the British Columbia Electric Railway Co., Vancouver, B. C., to succeed the late Peter C. Gill.

Born in Victoria, B. C., Mr. Wollaston received his university training at the University of Washington. Following graduation in engineering, he entered the employ of the Commonwealth Edison Co., Chicago, where he has been actively associated with transmission and distribution for the past 18 years.

•

Roller-Smith Appoints J. F. Getz Sales Manager

J. F. Getz, formerly industrial sales representative for the Atlantic District of the General Electric Co., has been appointed general sales manager for the Roller-Smith Co., a division of Realty & Industrial Corp., with offices at Bethlehem, Pa.

Mr. Getz was graduated from Pennsylvania State College in 1935 and had been connected with General Electric for eight years.

•

▶C. M. MOSHER has been appointed to the engineering staff of the Edison Electric Institute. Mr. Mosher was formerly with Consolidated Edison System Companies, where for the past 21 years he has been identified with the work of the outside plant construction groups.

▶ROY N. MAUK, reclamation department, Oklahoma Gas & Electric Co., Oklahoma City, has retired, bringing to a close more than a quarter of a century of service with that utility. Mr. Mauk had been an engineer for the Hennessey Light Co. for four years when Oklahoma Gas & Electric bought the property in 1917. He continued as the local superintendent there for some time, later being transferred to Medford, and in 1933 to Watonga. His many years in the northern division closed with an assignment at division headquarters, Enid, in 1938. The following year he was transferred to the reclamation department, Oklahoma City, where he has been in the transformer section. During his 26 years with Oklahoma Gas & Electric Mr. Mauk has seen service in the meter, electric and reclamation departments, serving in a variety of capacities.

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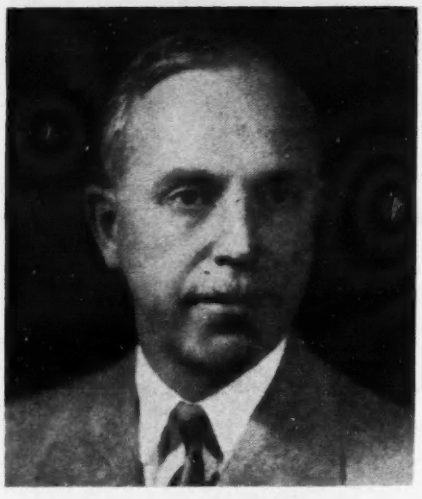
Utility Elects Officers; Chief Engineer Named

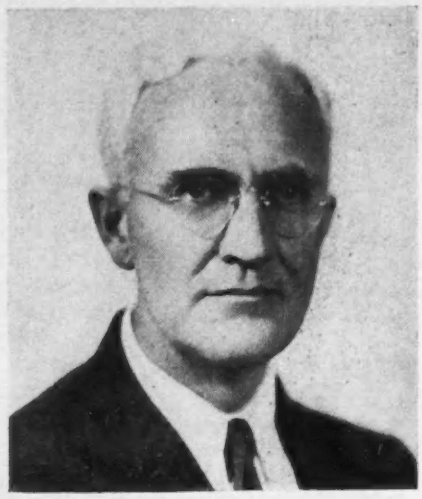
Detroit Edison directors have elected two new vice-presidents, Paul W. Thompson and Angus D. McLay. Mr.



P. W. Thompson

Thompson will have general responsibility for engineering and be in charge of power generation, central heating and the company's construction bureau. Mr. McLay will have charge of the sales department and will continue as sales manager. At the same time the appointment of Samuel M. Dean as chief engineer of the system was announced.

All three men have held executive positions with Detroit Edison for many years. Mr. Thompson has been chief engineer of power plants and had active charge of the design of the company's steam and electric generating stations. He joined the company in 1914, having



A. D. McLay

been graduated from Cornell University in 1910.

Mr. McLay became identified with the company in 1914 as superintendent of Eastern Michigan Edison at Ypsilanti. He went to the Detroit office of the Edison company as a sales engineer in 1915 and has represented the company in its dealings with large industrial power customers. In 1938 he became sales manager of the company. Mr. McLay attended the University of Michigan.

Sarah M. Sheridan, who has for many years had charge of the company's sales department and directed its policies, will continue her duties as the senior vice-president of the company.

Prior to his recent appointment as chief engineer of the system, Mr. Dean was chief assistant superintendent of electrical system, the position to which he was assigned in 1930, having joined Edison in 1925 as senior electrical engineer. He is a native of Traverse City, Mich., and a graduate of Michigan State College. In his new position Mr. Dean will have charge of the planning and engineering of the company's system.

S. M. Dean

They're Versatile!

Here are a few of the many models in the J-B-T line of Vibrating Reed Frequency Meters for measuring frequency of AC or interrupted DC. Vibrating reed indicates actual frequency or r.p.m.

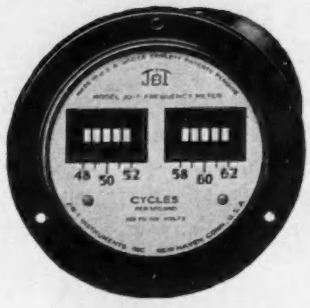
● versatile because they are being used on portable engine-generator sets in the field, where mud and grit and vibration are the rule, not the exception — in laboratories, where accuracy is the prime consideration—in telephone, television and radio service, and in the many types of electronic equipment where power consumption must be low—and in stationary applications where continuous operation demands durability.

● the list of uses grows daily. Many are wartime uses which cannot be specifically mentioned. It can be said, however, that thousands of J-B-T Vibrating Reed Frequency Meters are protecting vital equipment where successful operation depends on constant or known frequency.

● these instruments are not affected by wave form, normal temperature change or external magnetic fields. Accurate to ± 0.3% or ± 0.2% depending on the model, and available for frequencies from 15 cycles to 420 cycles, for various voltages, and with several reed groupings and case sizes, full or half-cycle increment, sharp or broad response.

Better requisition several ranges for your own use—they're so versatile, you'll wonder how you ever got along without them.

Model 31-F, 5 reed, half cycle increment.



Model 30-F, double window, for ease in reading frequency in either range.

Model 53-F, 5 inch, 9 reed, for front-of-panel mounting.

Model 60-FP, portable, covering four ranges.

For details on the complete line of J-B-T Frequency Meters, send for Bulletin VF-43—and if interested in 400 cycle meters, also for VF-43-1A.

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(Manufactured under Triplett Patents and/or Patents Pending)

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Phillips Heads Pittsburgh Westinghouse Division

Appointment of Thomas I. Phillips, vice-president of the Westinghouse Electric & Manufacturing Co., as head of the company's Pittsburgh divisions has been announced by George H. Bucher, president of the company. Mr. Phillips, who started with Westinghouse in 1915 as a tool maker, succeeds A. C. Streamer, who was named assistant to the president with headquarters in Pittsburgh.

Mr. Phillips became general works manager for the company in 1935, serving as central authority for all manufacturing operations. In 1941 he was named assistant to the president in charge of a headquarters manufacturing staff with supervision over several important divisions of the company. Later that year he was elected a vice-president. Mr. Phillips was awarded the company's "Order of Merit" "for his broad understanding of the technical and human problems of management, for his wisdom in matters of employee relationship and for his keen sense of justice and his thorough understanding of manufacturing technique."

Mr. Streamer joined the company in 1908 and for many years was connected with the development of large power equipment. In 1936 he was made manager of the switchgear division, three years later general manager of the East Pittsburgh division and in 1941 he was elected a vice-president.

•

▶ THOMAS C. MCFARLAND has been appointed chairman of the department of electrical engineering at the University of California, succeeding DR. L. F. FULLER, who recently resigned from the University of California staff. Dr. Fuller has entered the engineering department of the Joshua Hendy Manufacturing Co. at Sunnyvale.

▶ DOUGLAS C. TURNBULL, JR., formerly manager of the general service and public relations departments of the Consolidated Gas, Electric Light & Power Co., Baltimore, Md., has been appointed executive assistant of the Baltimore & Ohio Railroad Co. Mr. Turnbull will report to the president and handle special assignments for him. A native of Baltimore and a graduate of Johns Hopkins University, Mr. Turnbull entered the employ of the Baltimore utility in 1925 in the engineering department, first making studies of generating plant practice. He became identified with the steam stations department in 1927, and a year later went into the new-business department, handling contracts, industrial power prob-

lems and engineering and economic studies. He transferred to the general service department in 1940 and the following year was made manager of this department and also of the public relations department.

▶ H. M. ARCHER has been made head of the Detroit Research Laboratories, Inc., Detroit, recently organized to do independent general physical research of a special nature. His title is director of research. Mr. Archer is well known in the utility industry as a former Detroit Edison Co. man and for his pioneer work on infra-red drying. He is the author of some well-known articles on the subject. The Detroit Research Laboratories is at present doing all engineering testing for Svenson Engineering Service, manufacturers of infra-red equipment, also located in Detroit.

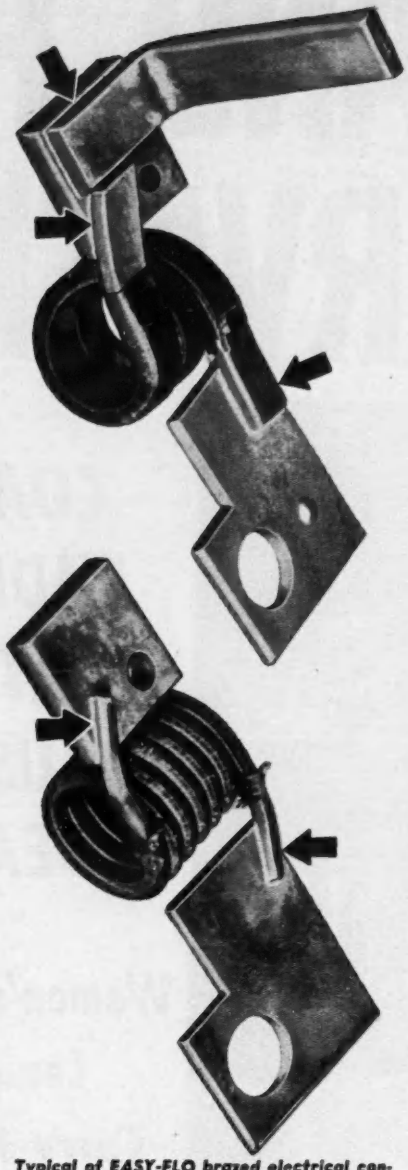
▶ ARTHUR J. SUTTON, for 14 years connected with Montreal Light, Heat & Power Consolidated, Montreal, Que., has been appointed design engineer of the British Columbia Electric Railway Co., Vancouver. Born in Aldershot, England, Mr. Sutton is a graduate of the Portsmouth Dockyard School of Engineering. Coming to Canada in 1929, he entered the service of the Montreal utility, where he was actively engaged in substation design.

▶ JOHN D. HAGGART, formerly connected with the Ontario Hydro Power Commission, Toronto, has entered the electrical department of the British Columbia Electric Railway Co., Vancouver, B. C. Previous to his connection with the commission, Mr. Haggart spent a number of years as electrical engineer with the Canadian Kodak Co. and five years as electrical engineer and as engineer with the Public Service Co. of Colorado. Born in Ontario, he is an engineering graduate of Toronto University. During his association with the commission, covering a period of some four years, he was actively engaged as design engineer on the Burlington transformer station.

▶ HERBERT R. WINTERS has been made sales manager of the central division of the Oklahoma Gas & Electric Co. and placed in complete charge of sales activities in that division. O. O. CRUTCHFIELD, who had general supervision over sales activities in this division, will devote his entire time to the sales activities of the Shawnee district.

▶ CORNELL T. EYFORD, for 18 years distribution engineer of the Winnipeg Electric Co., Winnipeg, Manitoba, Canada, has entered the distribution section of the electrical department of the British Columbia Electric Railway Co., Vancouver, B. C. Born in Winnipeg, Mr. Eyford was graduated from the Univer-

THE WAR-TIME AND ALL-TIME WAY TO GET efficient, trouble-free ELECTRICAL CONNECTIONS – braze with SIL-FOS and EASY-FLO



Typical of EASY-FLO brazed electrical connections are the two resistors shown above which come from the production line of a leading electrical manufacturer. They are used in electric motors.

The basic requirements of electrical connections are always the same. The characteristics always wanted are high electrical conductivity combined with strength and resiliency to withstand vibration, shocks, and temperature changes, plus resistance to oxidation and corrosion.

From a practical and profitable manufacturing standpoint, the best method of making electrical connections is the one that makes it possible to produce joints possessing all of these characteristics **in quick time** and **at low cost.**

And it is because this is exactly what SIL-FOS and EASY-FLO brazing does, that these two low temperature, free-flowing alloys are today extensively used on all kinds of electrical connections including terminals, taps, windings, bus-bars, switch-boards and many others.

Because of their speed and reliability in making joints of exceptional strength, SIL-FOS and EASY-FLO are also widely used in making structural joints in switches, motors and a wide variety of other electrical equipment, and in electrical repair and maintenance work as well.

BULLETIN 12-A WILL BRING YOU FULL DETAILS

This recently printed bulletin fully explains the reasons for the strength, reliability, speed, and economy of SIL-FOS and EASY-FLO brazing. It also tells how to put these alloys to work, and contains much useful information on joint designs and production-boosting heating and handling methods. Write today for your copy.

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ROBERTSHAW BROADCASTS AID FOOD AND FUEL CONSERVATION

COAST-TO-COAST RADIO PROGRAMS FEATURE CORRECT USE OF OVEN HEAT CONTROLS

Women's Interest Programs of Leading Radio Stations Carry Robertshaw Messages

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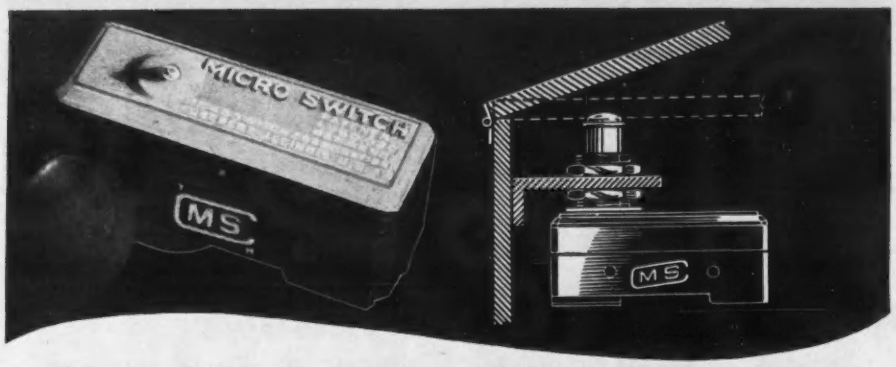
MILLIONS OF HOMEMAKERS LEARNING ADVANTAGES OF ROBERTSHAW OVEN HEAT CONTROLS—SALES ADVANTAGE SEEN WHEN RANGES AGAIN AVAILABLE

TUNE IN THE ROBERTSHAW BROADCASTS OVER THESE STATIONS:

METROPOLITAN MARKET	RADIO STATION	RADIO PROGRAM	BROADCAST SCHEDULE
NEW YORK	WOR	Martha Deane	Mon. thru Fri.
CHICAGO	WGN	June Baker—"Home Management"	Mon. thru Sat.
LOS ANGELES	KNX	Galen Drake—"Housewives' Protective League" Combined with "Sunrise Salute"	Mon. thru Fri. Mon. thru Sat.
PHILADELPHIA	WCAU	Ruth Chilton—"For Women Only"	Mon. thru Fri.
BOSTON AND NEW ENGLAND MARKET	*New England Network* WBZ—Boston, Mass. WCSH—Portland, Me. WTIC—Hartford, Conn. WLBZ—Bangor, Me. WJAR—Providence, R. I. WBZA—Springfield, Mass.	"Marjorie Mills"	Two days per week to alternate with "Yankee Kitchen"
	Yankee Network WNAC—Boston WEAN—Providence WAAB—Worcester WTHT—Hartford WLLH—Lowell—Lawrence WATR—Waterbury WHYN—Holyoke—Springfield WICC—Bridgeport WFEA—Manchester, N. H. WSAR—Fall River WCOU—Lewiston—Auburn, Me.	"Yankee Kitchen"—Ken and Carolyn	Two days per week to alternate with "Marjorie Mills"
DETROIT	WJR	"Mrs. Page's Household Economies"	Mon., Tues., Thurs., Sat.
PITTSBURGH	KDKA	Evelyn Gardiner—"Home Forum"	Mon. thru Fri.
SAN FRANCISCO—OAKLAND	KQW	Galen Drake—"Housewives' Protective League"	Mon. thru Fri.
ST. LOUIS	KMOX	Jane Porter—"The Magic Kitchen"	Mon. thru Sat.
CLEVELAND	WTAM	Jane Weaver—"Woman's Club of the Air"	Mon. thru Fri.
BALTIMORE	WBAL	Mollie Martin	Mon. thru Fri.
MINNEAPOLIS—ST. PAUL	KSTP	Bea Baxter "Household Forum"	Mon. thru Fri.
WASHINGTON, D. C.	WRC	Mary Mason—"Home Forum"	Mon. thru Fri.
BUFFALO—NIAGARA	WBEN	"The Food Magician" (O. P Stearns)	Mon. thru Fri.
CINCINNATI	WLW	Ruth Lyons—"Consumers' Foundation"	Mon. thru Sat.
INDIANAPOLIS	WIRE	Richard Stone	Mon. thru Sat.
ROCHESTER	WHAM	Hazel Cowles—"Women Only"	Mon. thru Fri.
DENVER	KOA	Lora Price—"Home Forum"	Mon. thru Fri.
SCHENECTADY	WGY	Betty Lennox—"Household Chats"	Mon. thru Fri.
KANSAS CITY	KMBC	Caroline Ellis—"The Happy Home"	Tues., Thurs., Sat.

Through the above outstanding women's interest programs on prominent radio stations, Robertshaw is urging millions of homemakers to demand Robertshaw Oven Heat Controls when new ranges are again available.

COMPANY YOUNGWOOD, PA.



There are hundreds of utility applications for Micro Switch

Long life, precise operation and close adjustment are proving Micro Switch increasingly dependable for use in utility applications.

Illustrated above is a panel mount Micro Switch for use as a cabinet door switch for safety, alarm or interlock on H. T. cabinets, transmitter or switch compartments. This is a normally open Micro Switch. When closed, the door actuates switch and closes circuit.

Micro Switches are supplied in a wide variety of housings and a broad range of actuating mechanisms to fit any application where a precision snap-action switch is required.

The basic Micro Switch is a thumb-size, feather-light, plastic enclosed precision snap-action switch that operates on force differentials as low as ¼ ounce, and movement differentials as low as .0002". It is listed by Underwriters' Laboratories with ratings of 1200 V.A. loads from 125 to 600 volts A.C.

Micro Switch Handbook-Catalog No. 60 contains complete details as to electrical characteristics, construction, applications, dimensions, and other information. We will be glad to mail it to you on request. Write for it today.

Micro Switch Corporation, Freeport, Ill.
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The trademark MICRO SWITCH is our property and identifies switches made by Micro Switch Corporation

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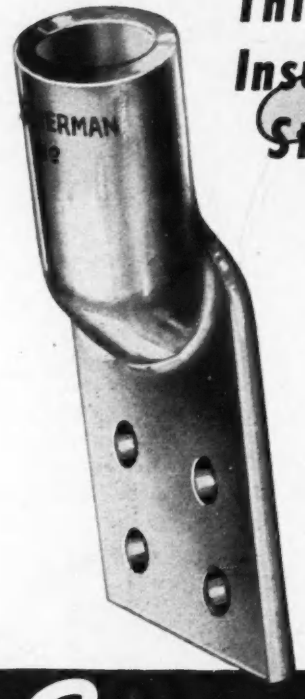

This Extra Deep Socket Insures Greater Mechanical Strength plus Higher Conductivity

Extra strength, to withstand any stresses — plus extra capacity to insure minimum IR drop! That's the combination that has made these Sherman Soldering Lugs the standard of the electrical industry.

Sherman Lugs are bright and clean, too, with no sharp edges or burrs — and the contact surfaces are FLAT.

Write for catalog which gives full specifications on a wide range of sizes and styles.

H. B. SHERMAN MFG. CO.
BATTLE CREEK, MICHIGAN

Sherman **HEAVY DUTY SOLDERING LUGS**

sity of Manitoba, and soon after became associated with the Winnipeg Electric Co.

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Electronics Department Appointments Announced

Arthur A. Brandt has been appointed general sales manager of the electronics department of the General Electric Co. In this capacity he will be responsible for the co-ordination of the sales plans and policies of the several divisions, and the operations of the electronics department district offices. George W. Henyan has been made assistant to the vice-president of the department and V. M. Lucas has been appointed manager of the government division. Mr. Brandt, formerly sales manager of the receiver division, was first employed by the General Electric Co. in 1937. He has spent a considerable portion of his time in the field and is well known to district offices, distributors, and dealers throughout the country. Mr. Henyan has been continuously associated with the company since 1916, and prior to his recent promotion served as manager of both the transmitter and tube sales divisions. Mr. Lucas, who has been in charge of all the transmitter division's government business, entered the employ of G.E. in 1923.

I. J. Kaar and G. W. Nevin have been appointed managers of the receiver and tube divisions, respectively, of the electronics department. The receiver division is located at the company's Bridgeport, Conn., works, while the headquarters of the tube division are located in Schenectady, with manufacturing plants in four cities. Mr. Kaar was formerly managing engineer of the receiver division and Mr. Nevin was chairman of the management committee of the tube division of the department.

C. A. Priest has been appointed manager of the transmitter division of the electronics department. In this capacity Mr. Priest will assume the responsibility for the operations of the Syracuse, N. Y., plant of the division and will have his headquarters in that city. Mr. Priest was engineer of the radio transmitter engineering division at Schenectady before his new appointment.

•

► JOHN P. WATERS has been appointed advertising manager of the lighting division of Sylvania Electric Products, Inc. Mr. Waters is widely known in advertising and merchandising circles, having been assistant director of advertising and promotion at Armstrong Cork Co. Previous to that time he had

NOW'S THE TIME TO DRIVE FOR WAR BOND SALES

AS YOU NEVER DROVE BEFORE!

Many a soldier owes his life to a commander who drove him to the utmost in battle—*never let him slacken for a single fatal instant!* And after the war, many a worker will owe his economic safety to a leader who drove him continuously for higher Pay-Roll allotments for the purchase of War Bonds!

Despite higher taxes and prices, the average worker still has more money than ever before—particularly on the basis of the *family* income. With others in the family earning, too, just let the worker 'figure it out for himself', and he usually will realize that *now* he can put more into War Bonds than he has been doing.

That's why the Treasury Department has set new quotas for the current Pay-Roll Allotment Drive—*quotas running about 50% above former figures.* These quotas are designed to reach the *new* money that's coming into the family income. Coming from millions of new workers . . . from women who never worked before . . . from millions who never before earned anything like what they are getting today!

The current War Bond effort is built around the *family* unit, and the Treasury Department now urges you to organize your War Bond *thinking*—and your War Bond *selling*—on the basis of your employees' *family* incomes. For details, get in touch with your local War Finance Committee which will supply you with all necessary material for the proper presentation of the new plan to your workers through your labor-management committees.

Today about 30,000,000 wage earners, in 175,000 plants, are buying War Bonds at the rate of nearly half a billion dollars a month. Great as this sum is, *it is not enough!* So turn-to today! Get this new *family income plan working!*

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

YOU'VE DONE YOUR BIT—NOW DO YOUR BEST

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This Space Is a Contribution to America's All-Out War Effort By

ELECTRICAL WORLD

ELECTRONIC Vigilantes

● Tiny electrons, destined to play such important roles in the future activities of man, are already serving in A.A.I. Automatic Alarm Systems as vigilant guards in the protection of important industries, properties and plants. Operating on the principle of sound detection, Automatic Alarms pick up vibrations inaudible to the human ear, report danger by both visible and audible signals and dispatch guards to the actual zone of disturbance. Here is round-the-clock protection against the constant threat of sabotage, espionage and theft. Automatic Alarm Systems are simple to install, require practically no maintenance and are relatively low in cost. Surround your industry with this electronic miracle.

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POWERSTAT Motor Driven Variable Transformers were pioneered by SECO. The engineers of Superior Electric Company have developed the only Motor Driven Variable Transformer having the features of

(a) Simple drive — no complicated gearing.
(b) Precise stopping when motor is de-energized, eliminating hunting and overshooting.
(c) Incorporation of a specially designed motor requiring no limit switches for protection when stalled.

For precise, simple control of AC power with automatic or push-button operation specify Motor Driven POWERSTAT Variable Transformers.

Send for Bulletins: 149 WE - POWERSTATS — 163 WE - Voltage Regulators

SUPERIOR ELECTRIC COMPANY

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SUPERIOR *Electric Company*

been with Union Carbide & Carbon Co. Mr. Waters takes the position vacated by B. K. WICKSTRUM, who has held the position for the past three years and who has received a special sales assignment reporting directly to Robert H. Bishop, general sales manager of the lighting division of the Sylvania company.

► CLINTON BROWN has been appointed an account executive on the staff of Jos. W. Hicks, public relations and industrial relations counsel, Chicago. For the past 15 years, Mr. Brown has served as publicity and publications director, also directing sales campaigns and sales training for the Edison General Electric Appliance Co. He has resigned that affiliation to join the staff of the Hicks organization. Mr. Brown is widely known in the electrical and public utility fields and in advertising and publishing circles.

► THOMAS D. WILLIAMS has been appointed superintendent of construction of American Steel & Wire Co., Cleveland, Ohio, and JAMES MCCULLOCH has been named assistant superintendent of construction. Mr. Williams became associated with the Cleveland Rolling Mills, predecessor company of American Steel & Wire Co., in 1898, and since then has held various positions at the company's Newburgh Works, Cuyahoga Works and the city office, his latest position being assistant superintendent of construction. Mr. McCulloch has worked for American Steel & Wire Co. since 1915. He held various positions before being transferred to the chief engineer's office in Cleveland in 1937.

► DAVID M. SALSBURY has been appointed general manager of the Westinghouse Electric Supply Co., New York. Since January, 1939, Mr. Salsbury has been manager of the company's North Pacific district, with headquarters at Seattle, Wash. WILLIAM M. JEWELL, formerly acting manager at Detroit and manager at San Francisco, has been appointed district manager at Seattle and JOHN H. FISHER has been made Middle Atlantic district manager with headquarters at Philadelphia. Mr. Salsbury has been in the electric supply business since 1915, when he joined the Northern Electric Co. at Calgary, Canada. In 1918, after working for electric companies in Oakland and Fresno, Calif., he joined the Electric Railway & Manufacturer's Supply Co. in San Francisco. This company was acquired by Westinghouse in 1920. Subsequently, Mr. Salsbury served as branch manager in the company's Salt Lake City office until he was made district manager at Seattle in 1939. Mr. Jewell has served in the Washington,

D. C.; Richmond, Va.; San Francisco and Detroit offices of the company since 1925. He was manager at San Francisco in 1940 and 1941, before being transferred to Detroit in 1942. Mr. Fisher joined Westinghouse in 1913. From 1930 through 1940 he headed the Philadelphia office, then became manager of the northwestern district office at Chicago and in 1942 was made general manager at the company headquarters in New York.

▶R. L. McINTIRE, formerly superintendent of the central division of the Oklahoma Gas & Electric Co., has been appointed superintendent of the Shawnee district to succeed WALLACE GOREE, who is retiring.

▶PETER C. JACOBSON has been appointed engineer and superintendent of the General Electric cable division at its Oakland Works. He formerly was with the cable department at Schenectady. Mr. Jacobson was graduated from Washington State College in 1929 and joined G.E. at Schenectady during the same year. In 1935 he was made assistant to the superintendent of the wire department at Schenectady and later was promoted to general foreman of the cable department.

▶DR. A. ALLAN BATES, manager of the chemical and metallurgical division of the Westinghouse Research Laboratories, has been selected as one of three metallurgical experts to spend three months each in Brazil lecturing and making field trips through the mining areas. The appointments were made by the U. S. government at the request of the Brazilian government. Dr. Robert Mehl, head of the department of metallurgy at the Carnegie Institute of Technology, and Arthur Phillips, professor of metallurgy at Yale University, the other scientists appointed, will work under the immediate supervision of the Stevens Institute of Technology and the Office of the Co-ordinator of Inter-American Affairs. Dr. Bates has played a leading part at Westinghouse in the development of wartime substitutes for critical materials. He has established headquarters in the University of Sao Paulo Polytechnic School. There he is working with Brazilian experts in establishing the first metallurgical laboratory in South America and assisting in organizing a standard course in metallurgy at the school.

▶W. F. RAUBER has been appointed manager of sales of General Electric Co.'s outdoor and station equipment section, according to an announcement by R. F. Tinnerholm, manager of the company's switchgear division. Mr. Rauber has been associated with General Electric since 1923 when he entered the company's "test" course. He

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THESE SILV-A-KING "Victory" fluorescent lighting units are *inexpensive* and *immediately available!* Reflectors of non-critical, metal-saving Silv-A-Tex with high-gloss, baked white enamel reflecting surface are comparable in lighting efficiency to porcelain enamel and meet all RLM requirements.

If your plant, like most of those now in operation, was built for peacetime production, its lighting equipment was intended merely to supplement daylight *and is inadequate to meet the demands of full 24-hour war production!* Use Silv-A-King "Victory" units to *re-light* your plant, step up efficiency and production.

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SAVE TIME

in speeding the war program by using Reliable Straightline splices on new construction and on maintenance.

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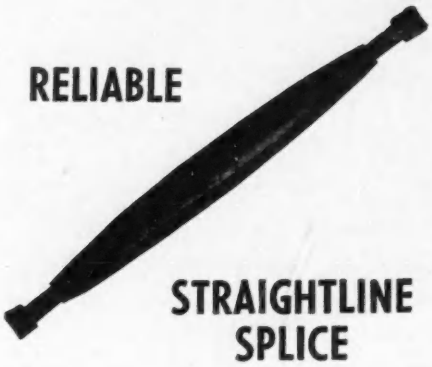
by using these perfect joint making units over and over again.



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Reliable
ELECTRIC COMPANY
OVER 35 YEARS SERVICE TO THE UTILITIES
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has been active in the company's switchgear business since 1924 when he was assigned to the sales department. In 1928 he became a switchgear specialist in the company's Cincinnati office, moved to the Cleveland office in the same capacity in 1931 and to Philadelphia in 1936. He subsequently became general assistant in the power circuit breaker sales section.

OBITUARY

► GEORGE C. SAWYER, vice-president and a director of the Shanghai Power Co., Inc., and a director of the Ebasco International Corp., died on September 20 at his home near Pompton Lakes, N. J., after a long illness. He was 57 years of age. Born in Manchester, N. H., Mr. Sawyer served for some years as an executive of the Montpelier (Vt.) Light & Power Co. Later he was associated with the Pacific Power & Light Co. as district manager with headquarters at Yakima, Wash., and then became assistant general manager of the entire Pacific Power system, with offices in Portland, Ore. He joined the Electric Bond & Share Co. in New York in 1929.

► WALTER L. WEST, general manager of the Nova Scotia Light & Power Co., Halifax, N. S., from 1919 to 1925, died recently at Concord, Mass., at the age of 69. At the time Mr. West was in Halifax the Nova Scotia utility was a subsidiary of Stone & Webster, Boston. He had managed Stone & Webster power properties in Paducah, Ky., and Tampa, Fla., as well as at Halifax.

► WILLIAM W. LEVERING, utility executive, died, of a heart ailment, on September 20 in Montreal, where he had gone on a business trip. He was 65 years old. Mr. Levering, who resided in Jenkintown, Pa., was born in Philadelphia. He was an officer of the Chestertown (Md.) Electric Light & Power Co., Lancaster Suburban Water Co. and the Toms River (N. J.) Water Co.

► J. HOWARD MATHEWS, chief engineer of the Illinois Commerce Commission, died at St. John's Hospital, Springfield, Ill., on August 7. Mr. Mathews was born at Yates City, Ill., in 1889. He entered the employ of the Public Utilities Commission of Illinois, predecessor of the Illinois Commerce Commission, after his graduation from the University of Illinois in 1914, as an assistant engineer. Following service in World War I, he returned to the commission as service engineer in 1919. In 1924 Mr. Mathews was appointed assistant chief engineer and six years later he was promoted to the position of chief engineer, the position he held up to the time of his death.

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Archer E. Knowlton, *Editor-in-Chief*

Associate Editor for Engineering, Electrical World

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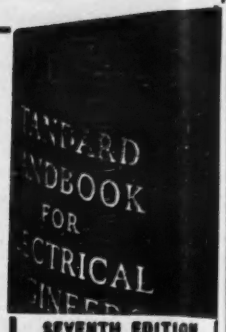

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Power Plant Economics
Power System Electrical Equipment
Power Transmission
Power Distribution
Wiring Design—Commercial and Industrial Buildings
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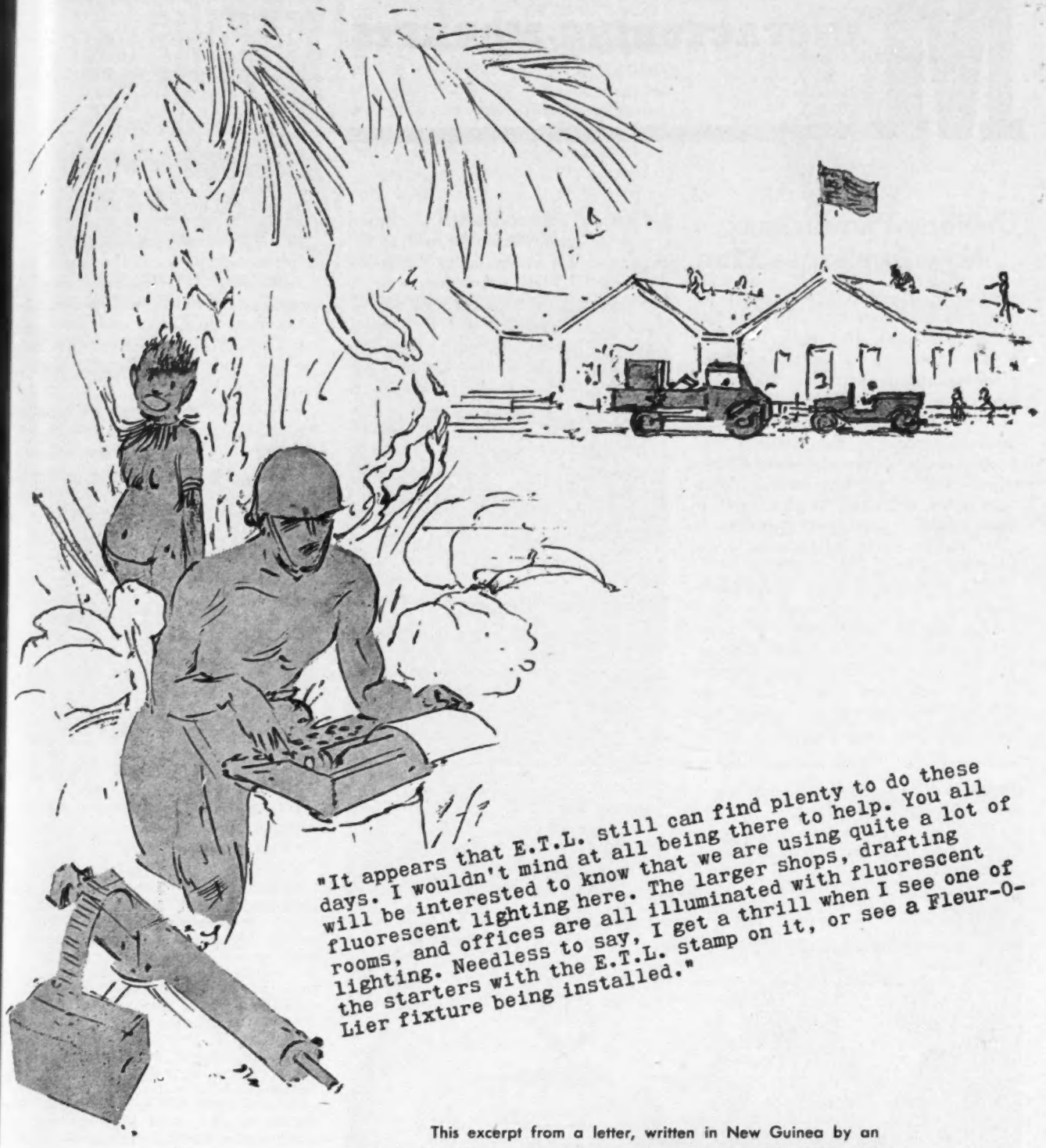

"It appears that E.T.L. still can find plenty to do these days. I wouldn't mind at all being there to help. You all will be interested to know that we are using quite a lot of fluorescent lighting here. The larger shops, drafting rooms, and offices are all illuminated with fluorescent lighting. Needless to say, I get a thrill when I see one of the starters with the E.T.L. stamp on it, or see a Fleur-O-Lier fixture being installed."

This excerpt from a letter, written in New Guinea by an E.T.L. lad in the service, prompts us to state: IF FLEUR-O-LIER IS "FOR THE GOOD OF THE SERVICE" IN NEW GUINEA —IT WILL BE FOR THE GOOD OF THE SERVICE IN ANY ACTIVE SPOT IN THE U. S. A.

ELECTRICAL TESTING LABORATORIES, INC.

East End Avenue at 79th St., New York, N. Y.

MANUFACTURING-MARKETS

Universal Launches New Appliance Plan

Landers, Frary & Clark, manufacturers of the "Universal" line of electrical appliances, last week launched a new approach to post-war dealer planning with a campaign entitled "U Plan for V Day." Through the medium of full-color ads in most of the leading national magazines the company will attempt to crystallize consumer housewives' thinking on their electric appliance needs, and start to plan now for these post-war purchases, according to W. J. Cashman, sales promotion manager and author of the new plan.

Each ad carries a check list of appliances and housewares made by Universal, together with the 1941 price range of the item to be used as a guide. The housewife checks off the appliances she will need in one column, puts down their approximate cost in another column, and then takes the check list to her nearest Universal dealer to request a priority consideration as soon as the appliances are available. In the meantime the "U Plan" urges consumers to buy additional War Bonds now, equivalent to the amount needed for the appliances. It is suggested further that dealers set up a customer file on appliances, registering each customer on a priority basis.

Thus the "U Plan for V Day" is said to enable the consumer and the dealer to meet on a common ground, each helping the other to be prepared for an orderly flow of merchandise when the war ends.

•

Insulation Materials Sales Group to Move

Announcement has been made that the resin and insulation materials division of General Electric Co.'s appliance and merchandise department is moving its sales and order service headquarters office to Schenectady, N. Y., from Bridgeport, Conn., on October 4, according to E. L. Feininger, manager of the division.

This move brings the resin and insulation sales and order service into close association with the factory which is located in Schenectady.

•

Boom Period Viewed as Post-War Danger

Post-war unemployment will be practically non-existent and the nation faces the prospect of an immediate post-war boom, Lewis H. Brown, president of Johns-Manville Corp., told the American Trade Association Executives meeting last week at the Hotel Pennsylvania in New York.

Mr. Brown pointed out that wartime restrictions on production for domestic markets has created huge accumulated shortages that must be supplied and added that this, together with the tremendous task of reconverting to peacetime production, will make for "the danger of an immediate post-war boom, rather than a depression. Our problem will be to prevent a disastrous runaway which could, if allowed to go uncontrolled, lead to an eventual collapse and depression."

•

Manufacturers Issue Earnings Reports

Among the electrical manufacturing companies issuing earnings reports recently are the following:

WESTON ELECTRICAL INSTRUMENT CORP.—Including subsidiary, for six months ended June 30, net profit $436,012 after charges and a provision of $4,291,600 for contingencies, including estimated adjustment in prices on war contracts and estimated federal income and excess profits taxes, after deducting estimated post-war refund of 10 percent for excess profits taxes, but exclusive of a post-war reserve. This net is equal to $2.71 a share on the 160,583 shares of capital stock. After deducting a reserve $139,400 for post-war adjustments, balance transferred to earned surplus was $296,612, or $1.84 a share. For the six months ended June 30, 1942, net profit totaled $358,218 equal to $2.23 a share. Federal tax provision for this period amounted to $2,653,000.

HOLOPHANE—For fiscal year ended June 30, net income, after charges and federal taxes, $297,017, comparing with net income of $322,270 in the preceding fiscal year.

DRIVER-HARRIS—For 1942, net profit, after $782,561 federal income and excess profits taxes after post-war refund and a $1,100,000 refund resulting from renegotiation of war contracts, was $404,381, or $4.43 a common share. This compares with 1941 net of $674,488, or $7.07 a common share.

CABLE DISPLAY—Lieut. Howard L. Cook, wounded flyer and guest speaker at the American Mining Congress at Cincinnati, inspects the U. S. Rubber Co.'s cable and wire for war uses during the meeting. Left to right: H. B. Allesin, U. S. Rubber Co.; Lieut. Cook; H. B. Schull, vice-president, Pyramid Coal Co.

48 SPRINGS

permit most versatile control set-up

Heavy Duty, multiple contact, positive action Lever Switch for:

1. Remote control or telemetering.
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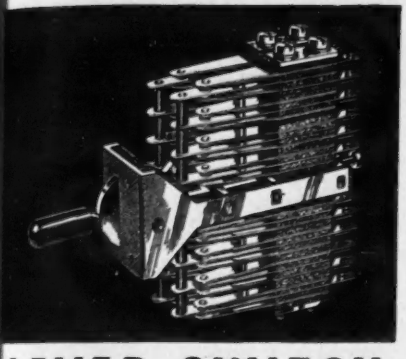


LEVER SWITCH
FOR ELECTRICAL CONTROL

Available in combinations as high as 12 springs per position, 24 springs per pile-up, or 48 springs total, the Series 4101 Lever Switch affords almost unlimited circuit arrangements. Any combination of five basic contact forms may be built up for each individual application.

Contact Ratings: (1) Standard heavy duty contacts—3/16" diameter fine silver—10 amperes, 110 volts, A.C.—non-inductive. (2) Extra heavy duty contacts—5/16" silver alloy—20 amperes, 110 volts, A.C.—non-inductive.

Breakdown rating of springs to ground—2000 volts—alternating current.

Write for new catalog illustrating the five basic contact forms with detailed drawings and data on mechanical construction of the 4101 Lever Switch and the full line of Mossman precision electrical components.

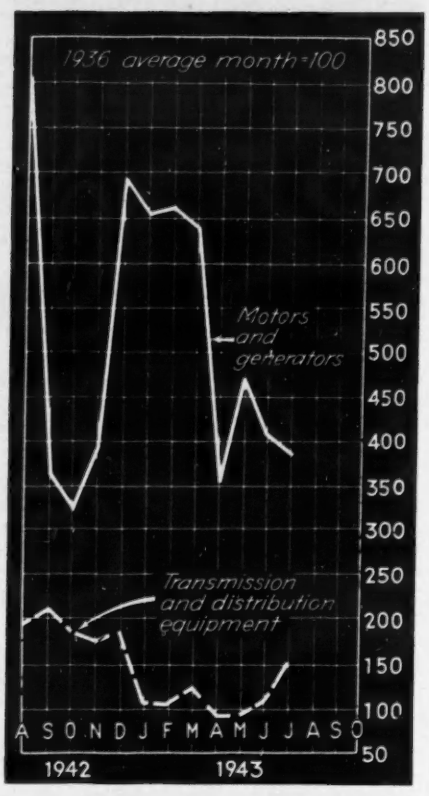
Donald P. Mossman, Inc.
6133 N. Northwest Highway
Chicago (31), Illinois

MOSSMAN
Electrical Components

Generator Orders Decrease; T. & D. Rise

Continuing the downward trend which started in the month of June, the index of new orders for motors and generators, compiled by the National Electrical Manufacturers Association, dropped 22 points, or 5 percent in July—June, 409; July, 387. The index figure of 387 compares with 627 for the month of July, 1942, a decrease of 38 percent.

The transmission and distribution equipment orders index advanced 41 percent in July—to 152 from 108 in June. It represents, however, a decrease of 32 percent as compared with July, 1942, when the index stood at 223.



NEMA INDEX. value of orders received

•

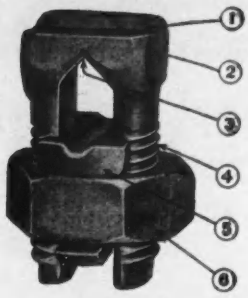
G.E. Awarded Contract

Announcement has been made that the Bonneville Administration has awarded a $130,157 contract to the General Electric Co. for capacitors to be delivered at Wenatchee, Wash.

•

Emerson to Pay Dividend

Emerson Electric Manufacturing Co. has declared a dividend of 15 cents a share on the common stock, or 5 cents more than the payments made in July and March.



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Reasons
WHY THEY ARE BETTER:

(1). Broad, strong head, with size plainly marked. Sides of head have flat surface so wrench or pliers can grip tightly.

(2). 100% Pure Copper, Cold forged bolt of ample strength for all purposes. High copper content prevents corrosion and season cracking. All edges are rounded.

(3). Modified "V" shaped groove, holds wires in three point contact and prevents rocking or looseness.

(4). 85% plus, full thread, die stamped, insures full engagement in nut, hence high strength connectors. No sharp edges.

(5). "V" groove clamping jaw of cold forged, 100% pure copper. Flanged sides give greater bearing surface on nut, hence greater strength.

(6). 97% copper content, hard metal nut—strong as steel. Full thread engagement with bolt.

(7). Made in 9 sizes—6 sizes of cold forged copper as illustrated and 4 sizes of machined high copper content alloy.

Send for bulletin and free samples and convince yourself of their superiority.

With Nut Retainer

W. N. MATTHEWS CORPORATION
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Short-Handed?

Do YOU want improved accuracy with less skilled operators?

The Photo-electric Tester for Watthour Meter Testing

provides:

Low Cost Testing
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Saving in Testing Time

A light beam and relays count the revolutions of the meter under test and automatically starts and stops the test meter.

Reduces Running Time

The inherent accuracy of this equipment makes long test runs unnecessary. Operators do not need to watch meters during the running period.

Catalog describing this test table is waiting for you.

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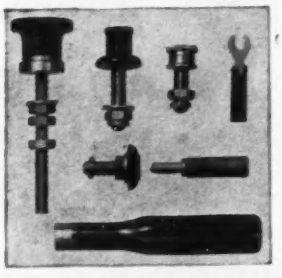

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Field Reports on Business

Reports from various sections of the country indicate that the electrical market continues buoyant. Small motor sales are being sustained at a high level of activity. Supplies for lighting and power installations in vessels are a feature of the electrical market at the present time.

NEW YORK

Federal Judge Francis G. Caffey last week entered an injunction restraining Local No. 3 of the International Brotherhood of Electrical Workers (A.F.L.) from interfering with the purchase or installation of electrical equipment made by eleven manufacturers whose plants are located outside of New York city. This was a judgment for the manufacturers who charged that the union was boycotting their products in New York. The manufacturers included Allen Bradley Co., Allis-Chalmers Manufacturing Co., Cutler-Hammer, Inc., Westinghouse Electric, General Electric, Trumbull Electric Manufacturing Co., Monitor Controller Co., Clark Controller Co., Electric Controller Co. and Colt's Patent Fire Arms Manufacturing Co. The judge's decree specifically forebade the union from adopting or enforcing any rule which would bar its members from handling, connecting, installing, wiring, assembling or working upon the plaintiff's products.

Retail trade continues brisk. The Federal Reserve Board reports that department store sales nationally for the week ended September 18 were 17 percent over the same week in 1942. The week previous the gain was 11 percent, and for the latest four-week period the increase is 7 percent.

Engineering construction awards for the latest week totaled $71,951,000, 66 percent above the preceding week, but 51 percent lower than the corresponding 1942 week, *Engineering News-Record* reports. The current week's total brings the 1943 volume to $2,437,651,000, which, on a weekly average basis, is 67 percent below the $7,632,606,000 reported for the 39-week period in 1942.

NEW ENGLAND

Small motor sales are being sustained at a high level as a result of the great activity in ship building which prevails in this district. From one source it is learned that the volume of such sales for August set an all-time record for a nationally known manufacturer, and indications are that September will show another unusually large booking. Supplies for lighting and power installations in vessels for the navy and merchant marine services are being rushed into local yards in large lots. Bids by manufacturers located in this district cover quantities of insulating materials, of which more than $40,000 in friction tape is noted, electric cable, more than 1,000 electric blowers, wall and bracket type electric fans, box connectors, wiring devices in large lots, small knife switches, over 2,000 storage battery type naval lanterns, and panelboard supplies.

In other fields the electrical market continues buoyant. Pratt Whitney Aircraft engines, totaling 5,000,000 hp., were manufactured during August and last week the company shipped its 100,000th engine from East Hartford, Conn. Over 5,000-kva. in capacitors have been installed on the United Illuminating Co.'s system, New Haven and Bridgeport, Conn., in the past two years.

Allocations of funds by the DFC for providing additional equipment in New England plants have increased in number during September. Raytheon Products Corp., Newton, Mass., has received an additional $500,000; United Aircraft has been allocated $2,200,000 for additional equipment to be set up in one of its plants. U. S. Rubber Co. will expand one of its plants in Rhode Island at a cost of $335,000.

CHICAGO

Chicago manufacturers of electrical switchgear and distribution equipment continue active war sub-contracting work outside their regular lines. They report, however, that orders for regular line products are few, small and scattered; the volume slightly off from the levels of spring and summer.

Most electrical manufacturers report, however, that they can pick up regular line production almost immediately after the war if material is available. A few of the firms, which have gone into sub-contracting work on a larger scale than others, estimate that conversion will require 60-90 days.

Dealers in used electrical equipment report that demand for both heavy and light motors has lessened. Motor repair work continues at high levels with considerable difficulty being experienced in obtaining skilled servicemen.

Industrial electrical contractors remain "busy" but with a noticeable decline in the number of new jobs pending. Most of the work now being done is involved in the rewiring of existing facilities currently undergoing expansion.

Department store sales in the principal cities in the Seventh Federal Reserve District continue to show increases. Department store stocks are reported lower in all classes except women's ready to wear. Supplies of major household appliances are less than a third of what they were in July last year, according to the Federal Reserve Bank of Chicago.

PACIFIC COAST

Total volume of building permits for the seven western states during August showed only 5 percent decrease from that of August, 1942; with Arizona, Oregon, Utah and Washington all showing increases. Los Angeles, Portland, Seattle and Spokane were the only cities in the million-dollar construction class during August.

Considerable wiring and lighting work is reported such as a $60,000 conversion job in Bay area for service Post Office; wiring the maritime warehouses in Richmond; and fluorescent fixtures for the San Francisco mint.

Orders include $25,000 motor-generator sets and condensers for a San Francisco drydock; a 1,000 kw. mercury arc rectifier for the Kaiser steel plant at Fontana, Calif.; thirty 350 kw. generators and controls, costing $140,000 for a naval base; and 32 electric sirens for Oakland.

The Schofield Dam near Price, Wash., will be constructed for $503,000. The Friant Dam, part of California Central Valley project, is being completed with control equipment borrowed from Boulder Dam, and 1944 deliveries from its irrigation storage are expected.

NEW SMALL RADIUS BENDERS
STOPS KINKS

Forming small-radius bends in tubing, conduit or pipe, without wrinkles, kinks, or serious distortion is a simple task with Greenlee Hand Benders. They form neat bends for sharp nooks and corners . . . eliminate manufactured bends and fittings . . . save up to 75% in time and material on many jobs. Special clamping device prevents slipping . . . stops kinks.

NEAT BENDS ENHANCE APPEARANCE OF JOB!

Shown above is a series of bends in thin-wall conduit made with a Greenlee No. 764 Bender. These smooth, small-radius bends eliminate fittings and provide a finished appearance to the job. On this high-production machine, fittings were used only at the end connections.

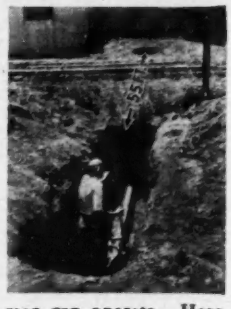
Available to essential users, Model No. 761 bends pipe and rigid conduit (IPS); No. 763 handles steel, copper, brass, and aluminum tubing; No. 764 for thin-wall conduit (EMT). *Write for more information—ask for new circular S-120.*

COMPLETE LINE OF BENDERS

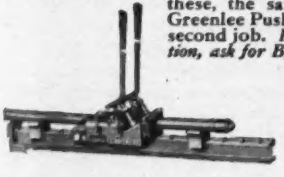
For any bending job there is a Greenlee Bender, including powerful hydraulic benders for conduit pipe and tubing from 1¼" to 4½" size. They are easily operated by one man and are compactly built into one unit. They save the cost of many manufactured bends. Portable, they are easily carried to the job and set up.

HYDRAULIC PIPE PUSHERS

Here is another Greenlee tool that saves hours of work and conserves manpower. When installing iron pipe or concrete duct underground, use a Greenlee Hydraulic Pipe Pusher. It's the only fast, easy method of installing pipe without tunneling, without digging or backfilling long trenches, without cutting pavement or tearing up road beds.



As shown at right, only a short trench is needed to accommodate pusher and pipe. One man can operate. Here, with a Greenlee No. 790 Pusher, 4" pipe was pushed a distance of 55 feet under the double, main-line tracks of railroad. Thru pipe main power lines were laid between two buildings. On jobs like these, the savings pay for a Greenlee Pusher on the first or second job. *For more information, ask for Bulletin No. S-117.*



WRITE FOR FREE COPY CATALOG 33-E

Greenlee TOOL CO.

1810 COLUMBIA AVE., ROCKFORD, ILL.

Sales Opportunities

MONTANA—Bureau of Reclamation, Denver, Colo., will begin surveys soon for proposed new transmission line from Fort Peck hydroelectric power station to serve reclamation project in eastern Montana, also a transmission line for power supply for pumping stations. Entire system will comprise close to 500 miles, with switching stations, power substations and other operating facilities. Cost estimated close to $5,000,000.

TEXAS—Humble Oil & Refining Co., Humble Building, Houston, will carry out expansion in oil refinery for production for government, with installation of machinery and electrical equipment. Cost estimated about $2,750,000, with financing by Defense Plant Corp. Work will be carried out soon.

OHIO—War Department, Washington, D. C., has authorized new military cantonment, comprising shops, warehouses and other industrial buildings, with mechanical and electrical equipment. Also power substation facilities, with distribution lines, service connections, etc. Project will include barracks, mess halls, officers' buildings and miscellaneous structures, and is reported to cost about $3,000,000. It will be supervised by U. S. District Engineer Office, Wright Field, near Dayton.

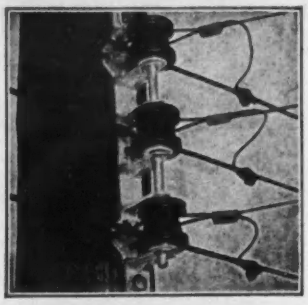
VIRGINIA—Civil Aeronautics Authority, Washington, D. C., has plans maturing for new airport, comprising hangar, shops and miscellaneous structures, with mechanical and electrical equipment. Also distribution lines, control station, lighting system and other operating facilities. Cost estimated close to $600,000. Proposed to award contracts in about 60 days.

CONNECTICUT—United Aircraft Corp., East Hartford, will make further extensions in plant for production for government, including additional buildings and installation of machinery and electrical equipment. Cost estimated about $880,000, with financing by Defense Plant Corp. This is in addition to recently announced fund of $2,200,000, provided through same source for similar factory expansion, making total of $3,080,000 for entire project.

UTAH—U. S. District Engineer Office, 32 Exchange Place, Salt Lake City, has plans for new transmission line and electrical distribution system at Wendover. Contract will be awarded soon.

ARIZONA—War Department, Washington, D. C., has approved plans for new military cantonment, comprising shops, warehouses and other industrial structures, with mechanical and electrical equipment. Also power substation facilities, electrical distribution lines and service connections. Barracks, mess halls and other buildings will be erected. Entire project will cost over $1,000,000, and will be placed under way at once. It will be supervised by U. S. District Engineer Office, Los Angeles, Calif.

VIRGINIA—American Viscose Corp., Delaware Trust Building, Wilmington, Del., manufacturer of rayon products, will carry out expansion in mill, including several one and multi-story processing and production buildings, with machinery and electrical equipment to more than double present output of rayon yarn manufacture of 25,000,000 lb. per annum. Cost reported close to $5,000,000. Project has secured



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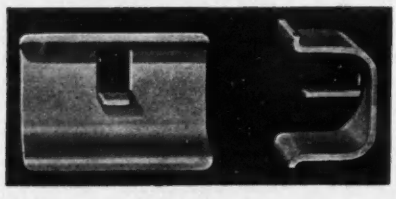

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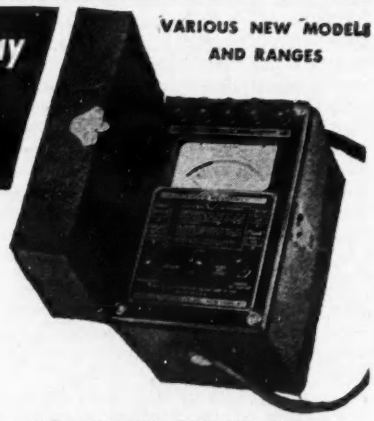

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priority rating from WPB, and work is scheduled to begin at early date.

FLORIDA—Navy Department, Washington, D. C., plans expansion in naval air station, comprising shops, warehouses and other buildings, with mechanical and electrical equipment. Also extensions in distribution lines and other electrical facilities. No estimate of cost announced. Lockwood, Greene Engineers, Inc., 10 Rockefeller Plaza, New York, N. Y., is consulting engineer.

MONTANA—Department of Public Works, Roundup, F. E. Liebetrau, commissioner, plans installation of an ornamental street-lighting system as a post-war project. Estimates of cost are being made.

NEW YORK—Charles Pfizer & Co., 11 Bartlett St., Brooklyn, manufacturer of pharmaceutical and chemical products, plans new plant in immediate vicinity of present factory for production of Penicillin, new mold-made bacteria-killing drug, with mechanical and electrical equipment for large capacity. Will include new boiler plant, towers for water-cooling service, refrigerating machinery and other apparatus. Cost estimated about $750,000. Work is scheduled to proceed at once. A priority rating has been secured.

NEBRASKA—Nebraska Mid-State Public Power & Irrigation District, Odessa, has plans under way for new power plant on Wood River, estimated to cost about $750,000, with turbine-generator, boilers and auxiliary equipment. Also will build transmission lines, power substation and distribution system. It is understood that a priority rating will be secured.

NEW JERSEY—Otis Elevator Co., 260 11th Ave., New York, N. Y., will carry out expansion in plant for production for government, comprising additional buildings, with machinery and electrical equipment. Cost estimated about $1,650,000, with financing by Defense Plant Corp. Project will be carried out at early date.

IOWA—Water Department, 1103 Locust St., Des Moines, Dale L. Maffitt, general manager, plans installation of two motor-driven pumping units, each with rating of 10,000,000 gal. in 24 hr., including controls and auxiliary equipment, in new pumping station to be built for increased water supply. Project will include an impounding reservoir and is estimated to cost about $600,000. Bids will be asked soon for pumping machinery and other equipment. Project has a priority rating. Alvord, Burdick & Howson, 20 North Wacker Dr., Chicago, Ill., are consulting engineers.

TEXAS—U. S. District Engineer Office, Fort Sam Houston, San Antonio, has plans maturing for new outside electrical distribution system, including lighting facilities, at a military project. Cost reported close to $100,000. Bids are scheduled to be asked soon.

WASHINGTON—Puget Sound Power & Light Co., Seattle, has approved plans for addition to outdoor power substation, to include installation of new six-unit transformer bank, with control building, untanking house, cooling pond and other facilities. Work will be carried out at once.

RHODE ISLAND—United States Rubber Co., 1230 Sixth Ave., New York, N. Y., will make extensions in plant, with installation of mechanical and electrical equipment for increased output for the government. Cost estimated $335,000, financing by Defense Plant Corp.

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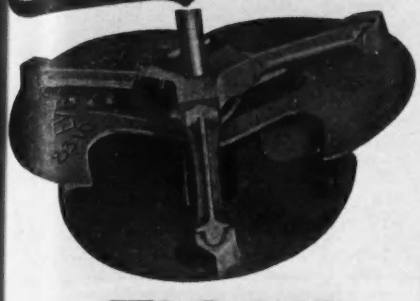

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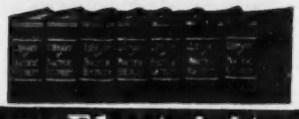

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LETTER TO THE EDITOR

Dispatchers Should Visit Plants and Personnel

To the Editor of ELECTRICAL WORLD:

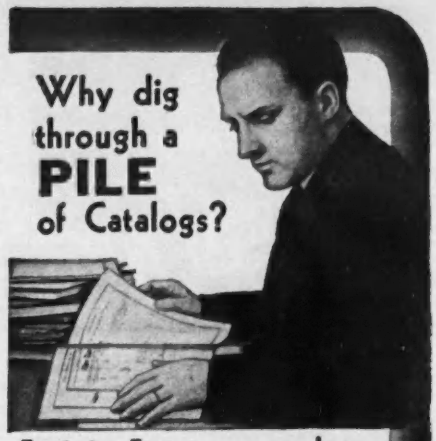
I have been reading ELECTRICAL WORLD for many years and have found it to be both interesting and educational. With special emphasis, would like you to know that your editorials of late have pleased me very much and I wish to make comment on two of them.

In the July 10 issue your editorial on the selection of load dispatchers was written with more understanding than is customary. I have been a load dispatcher since 1929 for the Illinois Iowa Power Company, handling the central and northern Illinois territories. I think you will find this to be the largest geographical territory handled by any dispatching office in the state of Illinois. I preceded this position with limited experience in the following classes of work: Groundman, patrolman, lineman on pole and steel tower line construction and on electric railway maintenance, substation electrician, substation operator and then to load dispatcher. Needless to say, my previous experience is highly beneficial in my work and is the basis of my interpretations from information transmitted to me from the field.

I feel that the dispatchers should visit substations and power houses and be as familiar with all the physical characteristics of the system as is possible. Furthermore, I think that it would be time well invested for the dispatchers to spend time periodically with the line crews, maintenance electricians, meter and relay men and all phases of the work which affects the load dispatcher. Without these contacts we would gradually become out-dated on policies and practices.

I have found that the profession of load dispatcher is not listed with the Army or Navy, and in my several contacts with each no one seems to know what we do nor can they seem to understand how we would be of any benefit to the war effort in either branch of the service. Therefore, I feel that it might be time to educate the Army, Navy and the public as to who the load dispatcher is and what he does.

Let me also thank you for your effort in the issue of August 7 to give thanks to the utility workers for their contribution to the war effort, under "Where Credit Is Due." I do not intend to fail in my duty and will do my job to the



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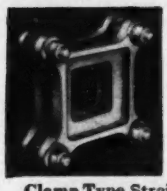

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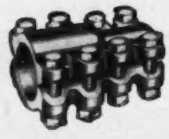

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Recent Rate Action

UTAH POWER & LIGHT Co. has been ordered by the state Public Service Commission to reduce its rates annually $1,504,644, effective October 1. Ruling in the case, which has been in progress since last November, the commission held that a rate base, founded on actual investment as of December 31, 1941, should be established at $63,970,254. In so doing the commission overruled a company contention for a value based on reproduction cost new of its property, a figure which would have been several million dollars higher. The order was signed by Chairman George S. Ballif and Commissioner Oscar W. Carlson. Commissioner Donald Hacking, dissenting in part, concurred in the amount of the rate base and the fixing of 6 percent as a fair rate of return, but held that the rate reduction should be $1,000,000 based on 1942 volume of sales, instead of $1,500,000 based on 1941's lower sales volume. The commission did not specify how the rate reduction should be spread among the various ratepayers, but ordered the company to file a new schedule putting the reduction into effect as of October 1. In a statement issued with the report and order, the commission said it was convinced the order would not interfere with "proper refinancing plans of the company," and "it appears to us that the equities of all investors in the company, and particularly preferred-stock holders, will be adequately protected." George M. Gadsby, president and general manager of the company, deplored what he termed the "unusual severity" of the $1,500,000 rate cut. "The alternate plan proposed in the dissenting opinion of Commissioner Hacking would have been of greater immediate benefit to consumers, would have created a post-war employment fund and, because of its less drastic effect in post-war years, would have allowed the company to proceed with the refinancing of its $44,000,000 debt due in 1944 on a favorable basis. Electric service in Utah at present rates costs substantially less than the national average. It has proved adequate for all purposes. It is not rationed and has not been found wanting in the crucial test of great increases in quantity for war establishments and the largest industrial activity the State has ever experienced. It is sold at pre-war prices at a time when practically every other commodity and service has gone up in price . . . We frankly deplore this action of the commission. The necessities of the company with reference to its refinancing and the interest of its preferred-stock holders have been consistently urged, but to no avail. . . ."

FRANKFORT ELECTRIC AND WATER PLANT BOARD, Frankfort, Ky., which began municipal operation of the local utilities in August, has announced that it has been notified by the Kentucky Utilities Co. that the rate for electricity furnished the Frankfort system at wholesale would be increased as of September 1. Leslie W. Morris, municipal plant board chairman, said the proposed increase would cost the city an additional $8,963 a year. Mr. Morris

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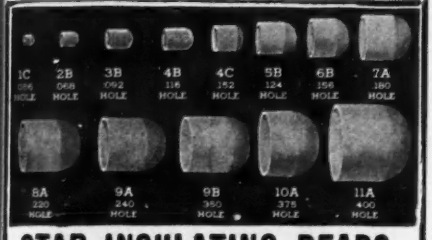

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and Harold K. Hines, manager of the municipal system, said that should the wholesale rate be increased there is little likelihood of a revision of present retail electric rates for consumers. A 15 percent cut on the average in retail rates was put into effect by the city after it acquired the systems from Tri-City Utilities Co. The rate increase, it was indicated, would affect the fund set up to retire the utility-revenue bonds issued to finance purchase of the utilities by the city. In notifying the municipality that it intended to apply the wholesale power service rate in lieu of the contract rate, Kentucky Utilities Co. said that the wholesale power rate was used in the sale of power by the company to other municipal plants. Mr. Morris said that a petition has been filed by suburban consumers, protesting against higher rates than those charged city users.

TUCSON (ARIZ.) GAS, ELECTRIC LIGHT & POWER CO.'s application for a rehearing on the State Corporation Commission's recent order, effective September 1, reducing the electric power rate for some 18,000 consumers in the aggregate sum of $175,000, has been denied by the commission. Application for a rehearing was filed by the company after the state tax commission boosted the valuation of its property by $1,200,000. The utility company contended that this increased its taxes by more than $60,000 and definitely affected the rate structure. Investigations on which the rate reduction was ordered were instituted by the commission on its own behalf in September, 1942, Commissioner William Petersen said. The tax increase was not established until after the rate cut order was issued, company attorneys pointed out in their application for a rehearing on the rate reduction, and thus the valuation increase was not taken into account when the rate cut was ordered. The commission ordered the reduced rates on the ground that the company was using cheaper electricity generated on the Colorado River.

CONSUMERS PUBLIC POWER DISTRICT (Nebraska) has announced a reduction in electric rates designed to save Nebraska city residential and commercial users an estimated $6,373 during the coming year. The reduction, effective with the September 1 billing, amounts to $3,700 or 6.15 percent for residential users and $2,673 or 5.9 percent for commercial users on an annual basis. Dan Hill, local manager for Consumers, said it was the second reduction for Nebraska City under Consumers' ownership.

INDIANAPOLIS POWER & LIGHT CO.'s power bill to the City of Indianapolis has been protested by Mayor Robert H. Tyndall, who has appealed to the state Public Service Commission to cut the charges. In a letter to the commission, he recommended an investigation of the city rates "with a view toward lowering them." He cited the 1942 bill of $416,754 to show the city was one of the largest customers of the Indianapolis Power & Light Co.

JAMESTOWN (N. Y.) BOARD OF PUBLIC UTILITIES rate schedule is being investigated by the state Public Service Commission. At a recent hearing Roland C. Buckman, principal rates examiner of the state commission, suggested a reduction in residential and commercial rates as a substitute for the Board's present program of distributing its annual surplus to consumers in the form of dividends.

WISCONSIN PUBLIC SERVICE COMMISSION has announced that electric, water and telephone utilities in the state reduced their rates $80,000 net a year during the first half of 1943. Electric utilities made the largest rate reductions, $83,354.

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Let them save your time by bringing their broad experience in their specialty to bear on your problems.

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NEW ADVERTISEMENTS received by 10 A. M. October 8th will appear in the October 16th issue subject to limitations of space available

WANTED

SALES EXECUTIVE

A prominent Eastern manufacturer in the electrical industry is looking for a Sales Executive to plan its postwar expansion program and to lay out an aggressive sales campaign for an old, established, well-accepted line of fractional horsepower motors and other industrial electrical equipment.

The applicant must have broad sales experience and have directed salesmen, advertising, and promotion. He must know the electrical industry, the avenues of marketing to manufacturers of equipment requiring electrical devices, be capable of planning an aggressive sales promotion and supervising its execution. In reply, give full particulars of education, past experience, salaries earned, and when available for employment.

This is a big job for a big man. Box Number 24W. Doremus & Company, 120 Broadway, New York 5, N. Y.

SUCCESSFUL MANUFACTURING CONCERN
FOR SALE

Well-established company manufacturing terminal boxes, control and switchboard panels, meter housing boxes and other electrical products, well-located in large Southern city, offered for sale as going concern. Modern plant with complete and up-to-date machinery. Address

BO-598 Electrical World
330 West 42nd St., N. Y. C. 18, N. Y.

Sell Your Surplus Meters NOW While There is Still a Market!

—WANTED TO BUY—
USED WATTHOUR METERS

(ESPECIALLY INTERESTED IN LARGE LOTS)

As Registered Used Meter Dealers we are permitted to purchase used meters, subject to release from Limitation Order L-151

Atlantic Electric Meter Co., 142 East 32nd Street, New York 16, N.Y.

Meters Bought, Sold, Tested, Repaired.

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SALARIED POSITIONS — This advertising service of 33 years' recognized standing negotiates for high salaried supervisory technical and executive positions. Procedure will be individualized to your personal requirements and will not conflict with Manpower Commission. Retaining fee protected by refund provision. Identity covered and present position protected. Send for details. R. W. Bixby, Inc., 262 Delward Bldg., Buffalo, N. Y.

EXECUTIVE—ENGINEERS—A dignified advertising service that confidentially conducts negotiations for executive and engineering positions in all fields. Our procedure sufficiently flexible to meet your personal requirements; will not conflict with Manpower Commission. Identity kept confidential, and if employed, position protected. Details on request. Harry F. Jepson & Associates, 605 Land Bank Bldg., Kansas City, Mo.

POSITIONS WANTED

ELECTRICAL ENGINEER. Registered. Experienced in supervision of Design, Construction and Operations. Father. Draft age. Desire connections with essential industry within United States. PW-603, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

EXPERIENCED UTILITY managing executive open for engagement. New York interview. PW-607, Electrical World, 330 W. 42nd St., New York 18, N. Y.

POSITION WANTED—Man experienced in electrical production, transmission and distribution operation, maintenance and construction, fifteen years in various responsible supervisory capacities. Technical graduate. Training qualifies for work in either executive or engineering department. Married, excellent health, acquainted throughout middle west and mountain states. PW-608, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

PUBLIC UTILITIES MANAGER: Forty-nine years of age, married, twenty-seven years experience in electrical transmission and distribution, both construction and maintenance. Exceptional record in customer and employee relations. Would prefer connection with personnel department, must be permanent. Can furnish excellent references as to character and ability. Employed at present but available on reasonable notice. PW-609, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

SELLING OPPORTUNITIES

OFFERED—WANTED
Selling Agencies—Sales Executives
Salesmen—Additional Lines

WANTED

MANUFACTURERS' AGENT with Transformer Line in Chicago District with warehouse facilities, desires lines to go with same; such as Switches, Fuses, Solderless Connectors and the like. Can guarantee over 100 active accounts. RA-587, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

BUSINESS OPPORTUNITY

INDIVIDUAL PURCHASING operating electric utility wants $400,000 equities money secured by serial notes and twenty percent bonus of common stock earning about $8000 after all charges. Management contract considered. BO-610, Electrical World, 330 W. 42nd St., New York 18, N. Y.

WANTED

ANYTHING within reason that is wanted in the field served by Electrical World can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

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For Sale

Complete operating Diesel electric generating plant consisting of 4 direct connected units, total name plate capacity 1960 BHP—1450 K. W. including panel boards, exciters, tanks, piping, etc.

Excellent operating condition. Held as stand-by plant for last ten years.

LOCATED ON EAST COAST

Inspection invited

FS-509, Electrical World
330 W. 42nd St., New York 18, N. Y.

Power Equipment

Released by Utilities & Industrials

Turbines, Generators, Steam and Oil Engines, Boilers, Motor Generators, Rotaries, Transformers, Motors, Compressors, etc.

Service backed by 38 years' experience

BREW, WOLTMAN & CO.
30 Church St., New York

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Large quantity

8,000-gallon 10,000-gallon
Built for 60# Hydrostatic and 25# Air Tests.
CLEANED—TESTED—PAINTED

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Also TANKS, Commercial, Vertical and Horizontal

From 2879 to 12,500 gals. and even much larger.

IRON & STEEL PRODUCTS, INC.
38 years' experience
13438 S. Brainard Ave., Chicago 33, Illinois
"ANYTHING* containing *IRON* or *STEEL"

IF THERE IS

Anything you want

that other readers of this paper can supply

OR—

Something you don't want

that other readers can use, advertise it in the

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FOR SALE

ELECTRICAL

Cable and Wire
Insulators, Indoor Bus bar type
Motors & Generators
Oil Circuit Breakers, indoor & outdoor
Switches, Air break
Reactors
Transformers, Potential & Current
Metering Station—33Kv

GENERAL

Construction Equipment
Fittings
Girders & I Beams
Pumps
Water Current Gauging Equipment
Gas Plant Equipment
Accounting Equipment

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SAN DIEGO GAS & ELECTRIC CO.
S. R. ROBINSON, *Purchasing Agent*
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Phone Franklin 4121

—TRANSFORMERS—

SPECIAL - - - -
KUHLMAN ELECTRIC FURNACE TRANSFORMER
1000 KVA, 3-phase, 60 cycle
7200—124/72/55 volts
available for immediate shipment
Price quoted on request.

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M Since 1912 CINCINNATI 27, OHIO

New "SEARCHLIGHT" Advertisements

received by October 8th, will appear in the October 16th issue subject to limitations of space available.

Address copy to Departmental Staff

ELECTRICAL WORLD

330 West 42nd St. New York 18, N. Y.

SUCCESSFUL OPERATION GUARANTEED

Every Machine in This Ad is Owned Outright By Us

D C MOTORS

HP	Make	Type	Volts	Speed
1500	Whse.		550	330
1250	G.E.	MPC	550	130
800	G.E.	MPC	660	600
625	G.E.	MPC	500	130
600	G.E.	MPC	600	650/900
600	Whse.		260	150/275
350	G.E.	MPC	230	450
300	G.E.	DMC	230	400/600
300	Cr.Wh.	CMC	230	1150
300	G.E.	MPC	230	275/550
270	Whse.		500	250/400
250	Al. Ch.		230	525
200	Whse.		230	400
175	Whse.	SK	250	150/525
150	G.E.	RC-19A	230	800/1000
150	Whse.	SK-201	230	300/900
150	G.E.	MPC	230	250/450
125	G.E.	CO-1832	230	625
120	Whse.	SK-180	230	720
100	G.E.	LC-50	230	1200
100	Al. Ch.		230	950/1150
100	G.E.	RC-19	230	575/720
75	G.E.	LC	230	500/1000
75	Whse.	SK	230	475/900
60	El. Dy.	258	230	525/1050
50/60	Cr.Wh.	65H	230	500/1000
50	G.E.	RC-16	230	650/815

TRANSFORMERS

KVA	Make	PH	Type	Voltages
1667	Pitts	1	OISC	13200x2300
1050	G.E.	3	WCTH	11000x445
300	G.E.	1	H	13200x2300/575
200	Whse.	1	SK	6900x230/460
200	G.E.	1	H	26400x115/460
100	Whse.	1	OISC	13200x115

GEAR UNITS

2100 HP Whse., 1800/375 RPM.
943 HP GE 5306/1200 RPM.
720 HP DeLaval 3600/600 RPM.

MOTOR GENERATOR SETS

3 ph. 60 cycle

1—1500 KW GE 600 600 V. DC, Gen. dc. to 2100 HP—6000 V. Syn. Motor with exciter.
1—1000 KW G.E. 250 V. DC Gen. dc to 1400 HP—2200/132000 V. Syn Motor.
1—500 KW GE 660 V. DC Gen. d.c. to 700 HP—2200/13200 V. Syn. Motor with Exciter.
2—250 KW GE 250 V. Gen. d.c. to 375 HP—2200 V. Syn. Motor.

TURBO GENERATOR SET

1—500 KW, Whse. 625 Kva., 440 V., 3 ph., 60 cy., 3600 RPM with Parsons 145/175 lb. condensing turbine complete with jet condenser and accessories.
1—500 KW, G.E., 625 KVA, 2300 V., 3 ph., 60 cy. generator with Curtis 4 stage, 150 pound condensing turbine complete with condenser, etc.

ROTARY CONVERTERS

60 cycle

2—1500 KW, Whse. 720 RPM 650 V. DC with 3-single phase, 33000 V. transformers and panel.
1—1250 KW, G.E., 720 RPM 250 V. DC with 1375 KVA, 3 ph., 2300 V. Transformers and Panels.
2—750 KW, Whse. 1200 RPM, 600 V. DC with 2300/6600/11000 volts Transformers and Panels.
1—750 KW, Whse. 720 RPM 250 V. DC with three phase 6600/2300 V. Transformer and Panels.
1—375 KW, Whse. 1200 RPM 250/275 V. DC with 2200/6600 V. Transformer and Panels.
1—300 KW, G.E., type HCC, 1200 RPM, DC, 600 V. AC 6 ph., 1200 RPM.

25 cycle

3—1500 KW, G.E. 225/275 V. DC Booster type each with 1600 KVA, 3 ph. 6765 volt Transformers and Panels.
1—500 KW, G.E., 225/275 DC Booster type with 500 KVA 3 ph. 6765 volt Transformer and Panels.

A. C. MOTORS

3 ph. 60 cycle

Synchronous

	HP	Make	Type	Volts	Speed
1—	500	G.E.	TS	440	360
1—	250	G.E.	ATI	220	450
1—	225	G.E.	ATI	240	600
1—	200	Whse.		440	514
1—	168	Al. Ch.		2300	900
1—	159	Whse.	G	2400	900
1—	150	Whse.	G	2300	900
1—	150	Whse.		2200/550	1800

Slip Ring

1—	1200	Cr-Wh.	801-Q	2200	237
1—	800	Whse.	CW	440	357
1—	800	Al. Ch.		440	885
1—	600	G.E.	IM	2200	900
1—	450	Whse.	CW	2200	875
1—	400	G.E.	MT	550/440	300
1—	400	Al. Ch.		2300	505
1—	400	Al. Ch.		440	1200
1—	350	G.E.	IM	2300/4000	257
1—	300	G.E.	IM	2300	585
1—	250	G.E.	MT-410	2300	400
1—	250	G.E.	MT	4000/2300	257

Squirrel Cage

1—	500	G.E.	1-17B	2200	695
1—	400	Whse.	CS-1104A	2200	585
1—	300	Whse.	CS	550	580
2—	300	G.E.	1K	2300	600
1—	250	Al. Ch.		220/440	1150

SINE WAVE SET

Main unit—GE 3 unit, 4 Brg. consisting of motor—15/35 HP, 750/1800 RPM 230 V. DC Gen.—15 KW—220/110 V., 1800 RPM—3 ph., 60 cy.
Ref. Gen.—5 KW—36/18 V., 1800 RPM, 3 ph., 60 cy., with stator shifting.
Complete with Exciter Set. Voltage regulator, panels and accessories.

RENUBILT BELYEA MOTORS

What are your requirements? units up to 5000 kw available in stock.

BELYEA COMPANY INC.

Main Office & Shop: 51 HOWELL ST., JERSEY CITY, N. J.

J.L.HEMPHILL & CO. Inc.

ELECTRICAL ENGINEERS AND EQUIPMENT
1602 53rd Street, North Bergen, N. J.
N. Y. C. Tel.: LOngacre 5-3227—N. J. Tel.: UNion 3-2600

MOTOR—3 PHASE 60 CYCLE

1—5000 ampere, 6 volt, Hanson-Van Winkle
1—2000 ampere, 6 volt, Hanson-Van Winkle
1—1500 ampere, 6 volt, Hanson-Van Winkle
1—500 HP, 900 RPM, 440 volt, Lincoln slip ring
1—400 HP, 514 RPM, 440 volt, Westg., slip ring
1—335 HP, 600 RPM, 2300 volt, G.E. syn.
1—300 HP, 900 RPM, 440 volt, Lincoln slip ring.
1—250 HP, 514 RPM, 4000 volt, G.E., syn.
1—250 HP, 600 RPM, 4000 volt, G.E., sync.
1—200 HP, 600 RPM, 2200 volt, G.E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v. G.E., sl. rg.
1—150 HP, 1800 RPM, 440 volts, G.E., sq. cg.
1—150 HP, 900 RPM, 440 volt, Al. Ch. sl. rg.
2— 75 HP, 1200 RPM, 2300 volt, G.E., vertical.

MOTORS—D. C. 230 VOLTS

2—450 HP, 400 RPM, General Electric MPL.
1—250 HP, 750 RPM, Electro Dynamic.
2—150 HP, 550 RPM, Westinghouse, SK.
1—150 HP, 750 RPM, Electro Dynamic.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1— 65 HP, 1000 RPM, G.E., type BC.
1— 50 HP, RPM, Westinghouse, type SK.

TRANSFORMERS

2—400 KVA, G.E., 4156-240/480 v. Scott taps.
3—300 KVA, Pittsburgh, 7500/440 volts.
2—250 KVA, General Electric 6600/2200/220/440.
4—200 KVA, General Electric 2200/220/440.
8—200 KVA, G.E., 2200-220/440 volts.
3—150 KVA, G.E., 33,000 2300/4000 Y.
2—100 KVA, Westinghouse, 11,430/250 volts.
3—100 KVA, G.E., 2200-220/110 volts.
1—100 KVA, Pittsburgh, 1375/2750-110/220 volts.
3—100 KVA, Westinghouse, 13200 250 volts.
3—75 KVA, General Electric 2200/220/440.

MOTORS GENERATOR SETS

1—750 KW, 250 volt, Allis Chalmers, synchronous.
1— 75 KW, 125 volt, Crocker Wheeler, synchronous.
1— 35 KW, 125 volt, Elec. Machinery, sq. cage.

MOTORS—VARIABLE SPEED 230 VOLTS

1—750 KW, 250 volt Allis-Chalmers synchronous.
1—150 HP, 350/1050 RPM, Crocker-Wheeler.
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electric Dynamic.
1—35 HP, 500/15000 RPM, Westinghouse.
1—35 HP, 350/1050 RPM, Electric Dynamic.
1—30 HP, 225/900 RPM, Crocker-Wheeler.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker-Wheeler.

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 2300 volt, G.E.
1—225 KVA, 514 RPM, 600 volt, Westinghouse.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis Chalmers.

TURBO-GENERATORS

600 KW, Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 480 volt, bleeder
1—375 KVA, Westinghouse, non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 volt, cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 volt, cond.

ENGINE GENERATOR SETS

1—150 KVA, General Electric Generator, Ames Uniflow engine.
1—62½ KVA, Westinghouse Generator, Fairbanks company engine.

Complete Line of A.C. and D.C. Motors and Generators

FREQUENCY CHANGER

1000 KW, 460 volts, 3 phase, 25 cycle,
300 RPM, 1570 amperes, serial 4,900,000,
1250 KVA 0.8 p.f. 50-deg. rise General Electric, type ATI-10-1250M-300, with amortisseur winding, with 33 KW direct-connected exciter, with
1400 HP 460 volts, 3 phase, 60 cycle,
300 RPM General Electric, 1570 ampere
1250 KVA p.f. 0.9, 50-deg. type ATI-24-1250M-300 form C, with amortisseur winding.

CHICAGO ELECTRIC CO.

1314 W. Cermak Rd. Chicago, Ill.

NEW and USED EQUIPMENT AVAILABLE

for

Power Plants, Sub-Station, Transmission Lines and Construction

Send for new list . . . to

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EBASCO SERVICES INCORPORATED, TWO RECTOR ST., NEW YORK, N. Y.

ENGINE GENERATOR SET

250 KVA, 240 V, 3 phase General Electric Generator, Hewes & Phillips corliss engine, 120 RPM. Belt Driven exciter G.E. Type RC, 12 KW, 550 RPM, 125 V.

J. E. MERGOTT CO.

316 Jeliff Ave. Newark, 8, N. J.

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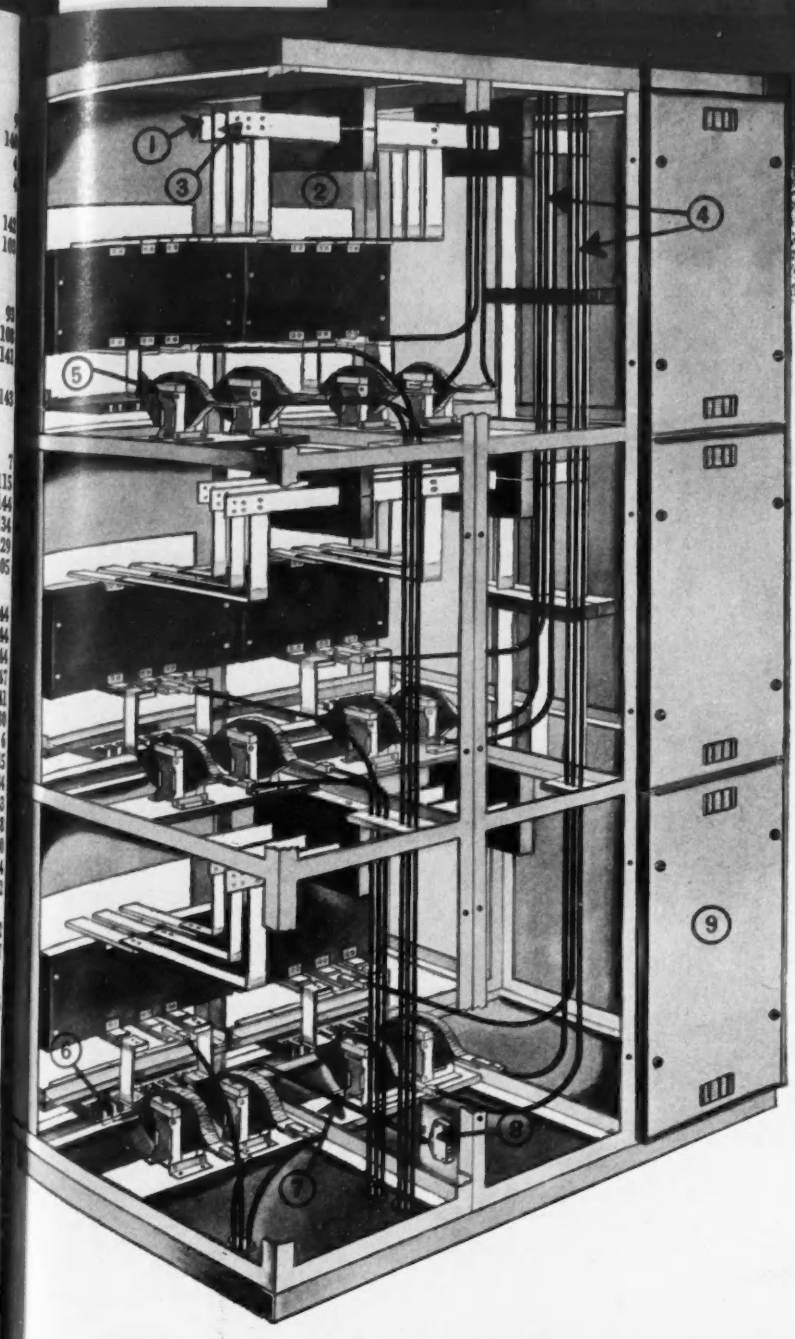
★ **These companies have supplied additional buying information on their products in the 1943 edition of the Electrical Buyers' Reference**



1 SILVER-PLATED BUSES—All buses and connection bars are silver-plated, giving permanent freedom from overheating at the joints. Buses are drilled for future extensions. Tubular or channel buses may be used for heavy currents.

2 BUS SUPPORTS—Blocks of insulating material impregnated with phenolic compound provide rigid support. Buses are braced for short circuit currents equal to interrupting rating of largest circuit breakers installed; minimum 25,000 amperes.

3 BOLTED JOINTS—All joints are made with two or four bolts with lock washers for permanent tightness. Silver-plating assures low millivolt drop. Where required, spacers maintain sufficient clearance for adequate ventilation between bars.

4 PRIMARY CABLES—May enter from floor or from overhead. Cable terminal connectors provided may be solder type or solderless clamp type, whichever purchaser prefers. Connector contact surfaces are silver-plated.

5 INSTRUMENT TRANSFORMERS—Current transformers connected in primary circuits as shown. Contact surfaces are silver-plated. Purchaser may specify make desired. Accuracy and burden to suit requirements. Potential transformers also available.

6 SMALL WIRING—No. 14 gauge (AWG) for control and protection circuits. Stranded, tinned, copper conductor insulated with synthetic rubber, flameproof felted asbestos and cotton braid. Dependable material for this essential service.

7 WIRING CONDUITS—Completely isolate control and signal circuit wires from primary conductors. Contribute an extra margin of safety with added security for operators and dependable operation of protective devices.

8 TERMINAL BLOCKS—Eliminate splicing, soldering and taping of small wiring and practically exclude possibility of high resistance joints and open circuits. Marking strips identify each wire without time-consuming tracing.

9 REMOVABLE PANELS—Completely enclose live parts; are readily removed for inspection. Flanged edges with welded corners make each panel stiff and free from warping. Bolts are attached and "lose-proof."

BUS COMPARTMENT DETAILS IN I-T-E DRAWOUT SWITCHGEAR

The details identified above represent standards of I-T-E design and construction. Such standards, however, should be noted in the light of an important, fundamental fact—that bus arrangements in switchgear enclosures are individual problems; that conditions of each installation are the guides. How deeply and thoroughly I-T-E examines the requirements of each job, can be gathered from a 24-page bulletin recently published, written by William Deans, Chief Engineer at I-T-E—"Electrical Buses and Bus Structures," Bulletin No. 4211. There have been more than 5000 requests for this bulletin; a few copies are available. For a point-by-point description of I-T-E drawout-type switchgear assemblies, including bus structures and compartment details, we have Bulletin 4207, which we will be pleased to send to you.

I-T-E

AIR SWITCHGEAR

IMMERSED IN AIR • ENCASED IN STEEL

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Representatives in Principal Cities

CIRCUIT BREAKER CO., PHILADELPHIA, PA.

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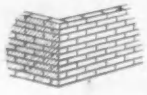
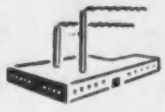
explosive non-inflammable cooling fluid, no expensive vaul[t]s

 are necessary in any type of industrial installation.  They can be

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